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XTEN

NATIONWIDE EMS PROPOSAL

by
Paul B. Warren
Charles E. Wilson
1979

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XTEN

NATIONWIDE EMS PROPOSAL

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B.S., Tuskegee Institute, 1974

A thesis submitted to the Faculty of the Graduate School of the University of Colorado in partial fulfillment of the requirements for the degree of Master of Science

Department of Telecommunications

1979

This Project for the Master of Science Degree by

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has been approved for the

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XTEN: Nationwide EMS Proposal

Project directed by Professor S.W. Maley

ABSTRACT

The purpose of this project is to explore the Electronic Message Service proposed by Xerox. The project is divided into two parts. The first part focuses on the features of the proposed EMS. This is done by discussing the system configuration, examining problems of existing systems, comparing XTEN to other EMS designs, exploring applications, analyzing cost benefits and the security measures that should be provided by such a system.

Part two examines the policy issues involved in the Xerox proposal. The threshold question of whether a market exists or not is dealt with. Then rule changes and the reallocation of the 10.55 to 10.68 GHz band are analyzed and recommendations are made. Finally, present regulatory policy is examined in terms of common carrier history and the XTEN proposal. Recommendations, concerning how, by whom and to what extent the EMS should be regulated are made.

In the conclusion, specific recommendations are summarized. It is the thesis of this paper that market forces should be allowed to regulate and that monopoly oriented rules should be dropped in respect to the EMS. In addition, appendix A briefly describes Time Division Multiple Access. Appendix B provides a detailed list of XTEN features. Finally, Appendix C briefly describes packet switching.

This abstract is approved as to form and content.

S.W. Maley
Chairman, Advisory Committee

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CHAPTER I

INTRODUCTION

On November 16, 1978 Xerox submitted a Petition for Rule-making to the Federal Communications Commission. In this petition they proposed a nationwide Electronic Message Service in the 10.55 to 10.68 GHz band. Also they proposed several changes in the rules to facilitate this service. Comments were filed and Xerox replied to them. On August 1, 1979 the FCC publicly declared their intentions regarding the proposed EMS. Essentially what they recommended was a notice of inquiry and a notice of proposed rule-making. Thus, the Xerox petition will be examined in more depth by the Commission before a decision is made.

Unlike many other EMS proposals, the Xerox plan provides local distribution without using any of the Bell System (unless they interconnect with another EMS). Although, a few of the other EMS systems also bypass Bell facilities, they do not provide the extensive intercìety and local distrubution services that Xerox does. As a provider of nationwide inter and intrabusiness communications for large corporations the Xerox EMS petition warrants serious consideration.

The intent of this project is to critically examine the Xerox proposal from two standpoints. First, in part one the system plan will be examined. This examination will encompass the first six subsequent chapters. Chapter two will provide the reader with the background of the system. Chapter three will examine the problems of existing systems and what types of services will be needed to solve these problems. Since other EMS systems have also been proposed, Chapter four will compare and contrast these systems. The applications of the proposed EMS will be discussed in terms of the potential users in chapter five. The long standing problem of security and what XTEN and other EMS carriers should incorporate in their designs to deal with it will be covered by Chapter six. The final Chapter of part one (Chapter seven) will analyze the cost benefits for subscribers of the proposed service.

The focus of part two will be on the questions of policy raised by the proposal. Chapter eight will examine the market for such a service. Once it has been established that a market does exist, then the specific proposal will be analyzed in terms of individual rules. Some recommendations will be made as to what rules should be changed. This will be done in Chapter nine. Finally, Chapter ten will examine specific policy issues and make recommendations as to the extent that the proposed EMS should be regulated.

Therefore, our thesis is that the Xerox proposal should be granted. But certain changes in the proposed rules should be implemented. Secondly, the extent to which EMSs are regulated should be reduced to foster a more competitive market which will hopefully spur innovation, efficiency and reduced costs, which in turn will better serve the public interest. In short, competition should be allowed a freer hand to regulate the industry.

CHAPTER II

BACKGROUND

Xerox has claimed to have made extensive efforts to identify the communications requirements of the office of the future. From these efforts they have supposedly uncovered the need for a "nationwide, high speed digital network that will transmit business information (i.e. facsimile, coded text, computer data), both expeditiously and at reasonable cost."[1]

This chapter will identify the technology used in this proposed high speed network. Additionally, major features of the system are discussed as well.

Background Information

On November 16, 1978, the Xerox Corporation revealed its intentions to join the communications carrier ranks when it petitioned the Federal Communications Commission to reallocate a portion of the radio spectrum in the microwave range (10.55 - 10.68 GHz). This range is requested for the purpose of establishing an Electronic Message Service (EMS) by common carriers. Xerox at this time also presented plans for the establishment of a Xerox subsidiary to handle its new domestic digital communications

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[1]Xerox Corporation Petition for Rulemaking (November 16, 1978) p.2.

network. This new digital network, designated Xerox Telecommunications Network will use a combination of satellite and radio links. It will allow geographically separated organizations to transmit business information from location to location, with little effort. XTEN, as described by Xerox, is to serve the office of the future.

Description

XTEN, shown pictorially in Figures 2-1 through 2-3[2] will offer high speed end-to-end digital communications service throughout the nation. It consists of eight key elements, the function of which will be explained briefly.[3]

1. User Terminals: Each message will enter the XTEN system through user terminals operating at a minimum transmission rate of 256 Kbps.

2. Equipment Interface: Outgoing information moves from user terminals to equipment interfaces. It is at this point Xerox will assume responsibility for message integrity and system maintenance.

3. Transceiver: From interfaces messages pass to the transceiver which is linked to a roof top antenna. The messages will then be beamed by radio link to a city node, or an intermediate sub node if needed.

4. Sub Nodes: The sub nodes serve as repeater links between transceivers and city nodes.

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[2]Ibid, p. 5, 6, 7.

[3]Xerox's XTEN brochure. p. 3.

FIGURE 2-1 PROPOSED XTEN SYSTEM

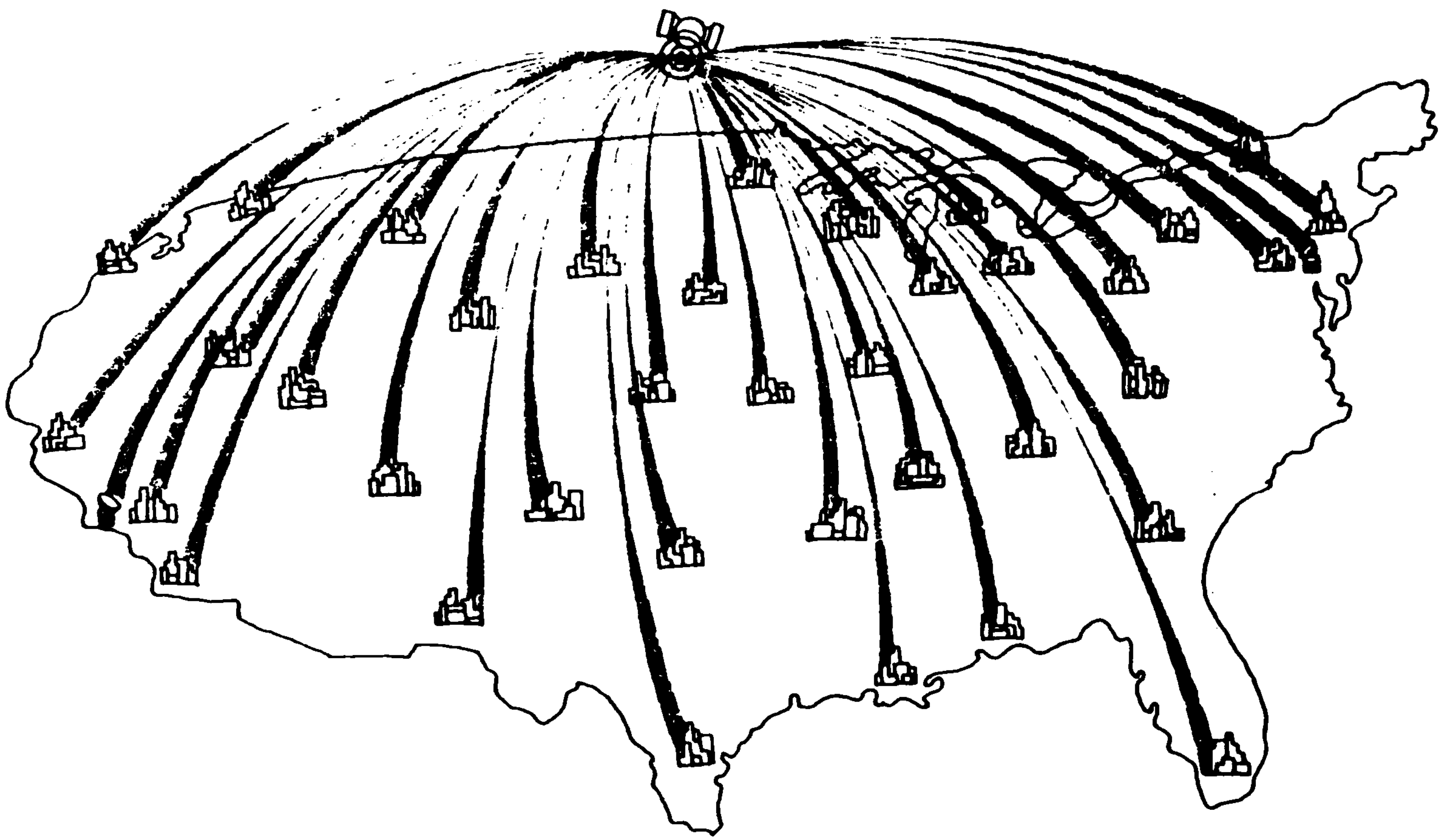


FIGURE 2-2 END-TO-END INFORMATION FLOW

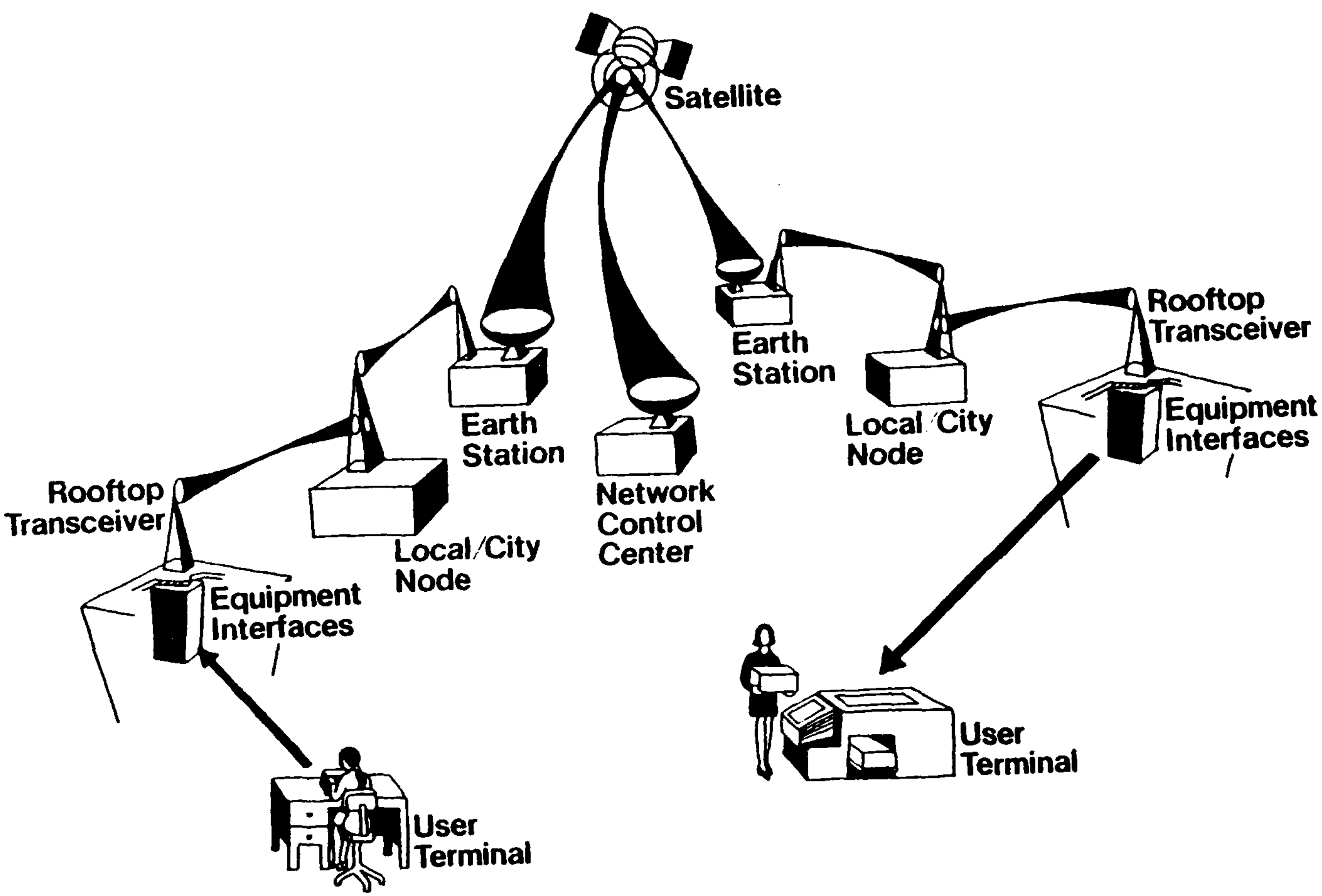
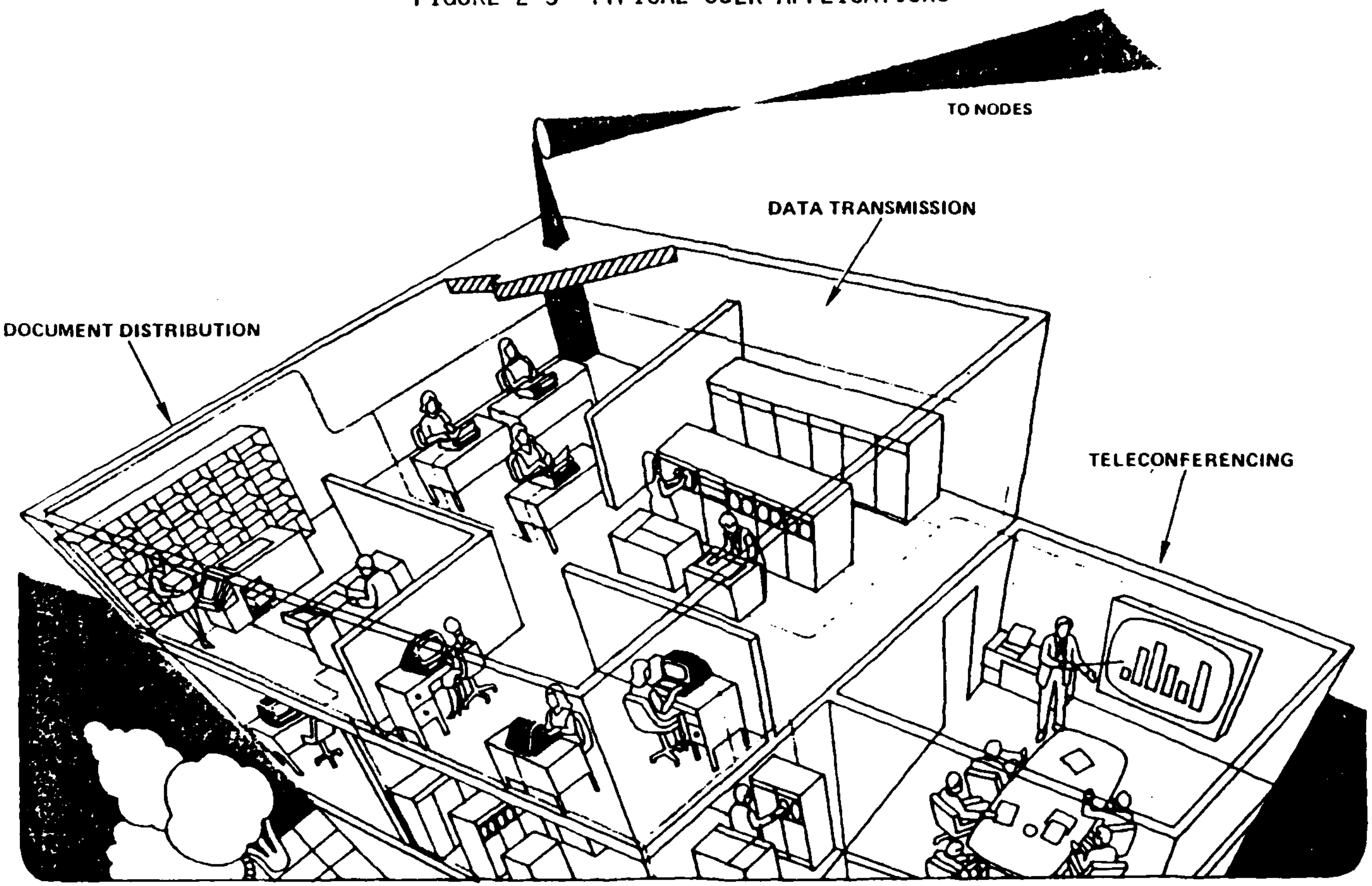


FIGURE 2-3 TYPICAL USER APPLICATIONS



5. City Nodes: City nodes represent the key element in XTEN's intercity transmission scheme and are also the hubs of the information distribution system. Because of different traffic flows associated with cities of varying sizes, XTEN will make use of three classes of city nodes. Class I will serve the largest areas and will access the satellite transponders on a time division multiple access (TDMA) basis (Appendix A provides additional information on TDMA). They will interconnect with Class II and III cities utilizing single channel per carrier (SCPC) transponder links. Cities of the Class II and III type will be served by the less expensive SCPC earth stations with reduced local data storage and message control functions.

6. Earth Stations: Information handling capability of the earth stations will depend on the amount of traffic within the area it supports. High capacity stations will probably be located outside of the larger U.S. metropolitan areas. They will transmit directly to the satellite and back and be connected to microwave links for passing information within city nodes.

7. Satellites: XTEN will utilize leased satellite transponders on communications satellites to complete the long distant network in the planned 200 city areas.

8. Control Centers: Two network centers will control the nationwide system. They will monitor the system's performance and traffic volume and also perform line fault diagnostics. In addition to these functions they will provide message audit and retrieval functions and accumulate accounting and billing information.

SYSTEM DESIGN

This section provides a technical description of the XTEN system. It will include the characteristics of the local nodes and subscriber stations and the frequency reuse patterns which are to be employed.

Local Node

Projected technical characteristics of local node stations are:[4]

Source	- All Solid State
Transmitter Carrier Frequency	-10.565-10.615 GHz
Transmitter Output Power	-0.5 watt per channel
Transmitter Frequency Stability	-1.0001%
Transmitter Modulation	-4 level FSK
Receiver Carrier Frequency	-10.630-10.680GHz
Receiver Noise Figure	-6 db
Antenna Systems	-Omni coverage; four 90° sectorized antennas Gain-17 dbi

Local nodes will incorporate fault alarms and redundancy. If a fault occurs, the alarm signal will be transmitted to the appropriate network control center.

Antenna design is critical to the cellular radio techniques employed. (Appendix B provides a description of a cellular radio technique). They are designed to provide wide angle coverage such that each node will be able to communicate with many different subscribers. Local node antennas will be split into three 120°

[4]Xerox's Petition, p. 30.

sectors or four 90° sectors. According to Xerox these configurations will offer the following advantages:

1. Better multipath performance can be obtained. Although subscriber antennas are directional, reflections can occur behind the local node antenna and present some multiplath interference if the antenna does not have adequate back lobe suppression. By using sector antennas, the back lobe can be attenuated preferably 25 to 30 db relative to the main lobe.

2. The top location on suitable structures for local node antennas will probably not be available. Sector antennas can be mounted part way up the structure and still achieve omnidirectional coverage.

3. Sector antennas will have higher gain than single omnidirectional antennas (between 5 db and 6 db).[5] Figure 2-4 shows the idealized radiation patterns for the local node antennas.[6]

Four sectors are shown which overlap a little at their edges to eliminate the possibility of "drop-outs" in the horizontal patterns. An aperture efficiency of about 70%, and a gain of 17 dbi, will be achieved.[7] The gain will drop rapidly beyond the sector edges to an average sidelobe level of about -10 dbi.[8] As a

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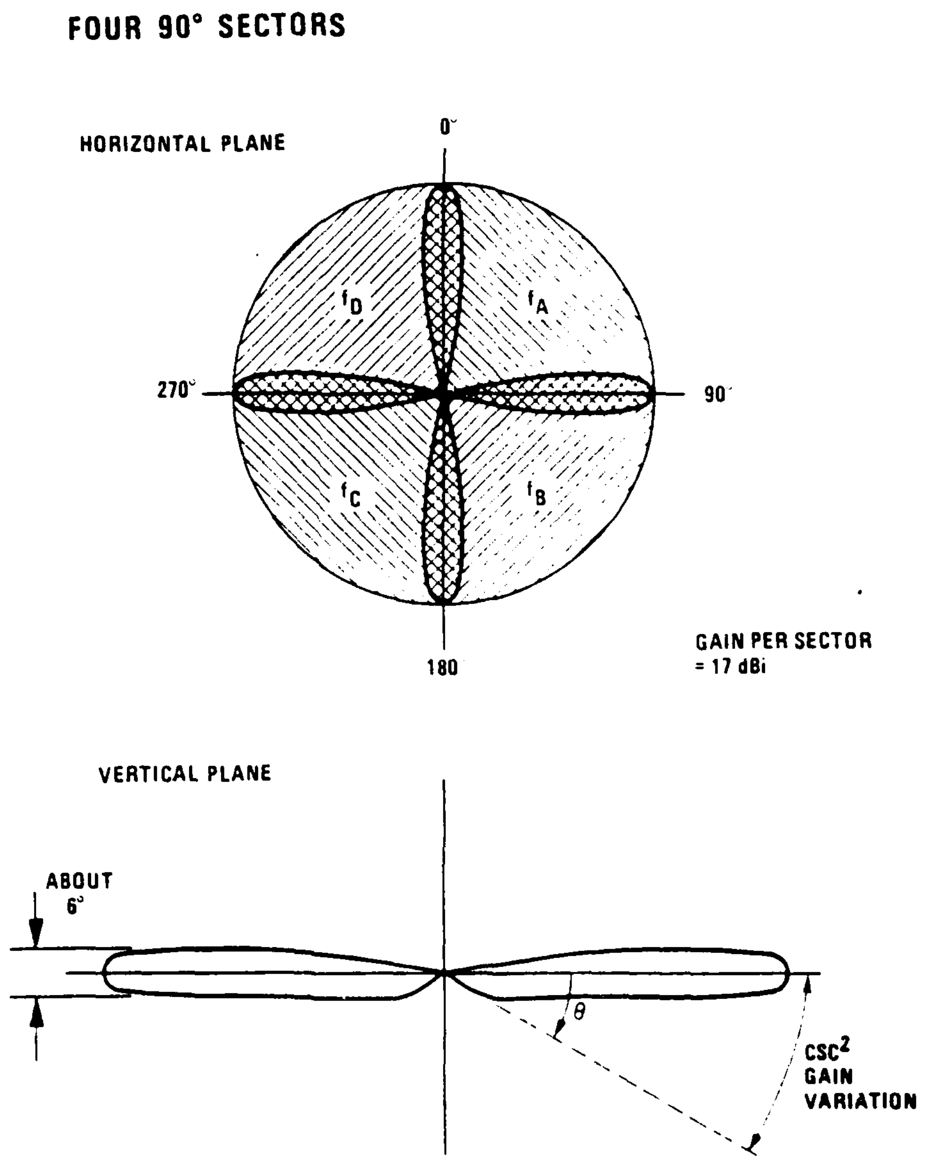
[5]Ibid. p. 31.

[6]Ibid. p. 32.

[7]Ibid. p. 31.

[8]Ibid.

FIGURE 2-4 LOCAL NODE ANTENNA PATTERNS



result of this, the front-to-back ratio of the sector antenna is anticipated to be about 27 db.[9]

In the elevation plane, a 6° beamwidth will be provided to compensate for most of the possible elevations of subscriber's antennas. In the cases where local node antenna installation is high thus making some nearby subscriber stations fall below the beam profile, the elevation pattern will be skewed on the underside to approximate a cosecant squared function, thus assuring adequate coverage of nearby subscribers.

Subscriber Station Design

For the XTEN system to be economical to the subscriber, the subscriber station installation cost must be kept as low as possible. Subscriber stations will be city node controlled and will transmit in assigned time slots. They will transmit on a point to point basis back to the local nodes. Projected technical characteristics are:[10]

Source	-All Solid State
Transmitter Carrier Frequency	-10.630-10.680 GHz
Transmitter Output Power	-.04 watt
Transmitter Frequency Stability	-.0005%
Transmitter Modulation	-4 level FSK
Receiver Carrier Frequency	-10.565-10.615 GHz
Receiver Noise Figure	-10 db
Antenna Systems	-Paraboloid (2 foot or 4 foot diameter) Gain-34 dbi to 40 dbi

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[9] Ibid.

[10] Ibid. p. 33.

The subscriber transceiver will accept all communications to its sector, however it will store locally only data which are addressed to the specific subscriber locations.

An access device will be provided to interface between users and XTEN. This device will format data from user equipment for transmission; it will also add the necessary addresses and signal codes.

Xerox has not made a definite decision on what the subscriber station antennas will be. They are considering a conventional paraboloid design, with a flexible mounting structure and either two or four foot diameter apertures. With 55% aperture efficiency, the two foot diameter antenna will have a gain of 34 dbi and a beamwidth of about 3.3^{o}; the four-foot antenna will have a gain of 40 dbi and a beamwidth of about 1.7^{o}.[11]

Frequency Reuse Patterns

In some metropolitan locations XTEN will use more than one local node, therefore the reuse of frequencies from node to node will be important in terms of spectrum management.

Using an antenna frequency division multiplexing technique (each antenna at a local node will be assigned a different frequency, or set of frequencies, to give continuous operation), the frequency assignment pattern shown in Figure 2-5 reuses the same four sets of frequencies among different local nodes.[12] A, B, C,

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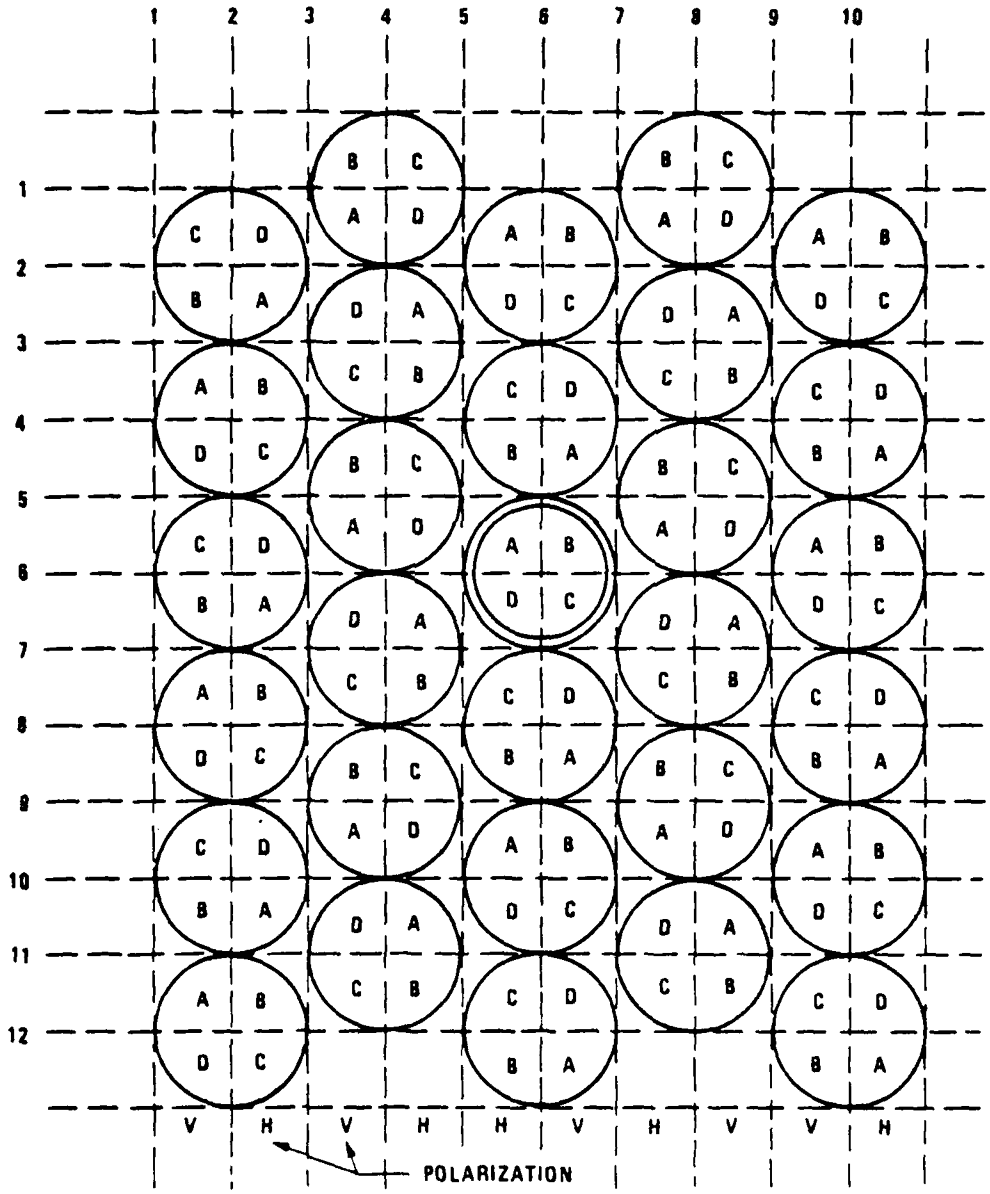
[11] Ibid. p. 34.

[12] Ibid. p. 37.

FIGURE 2-5 EXTENDED AFDM FREQUENCY ASSIGNMENT PATTERN



and D represent frequency assignments. By reversing the frequency assignments at each cell interface, the same frequencies may be reused from node to node.[13]

Internodal System Design

This system will be used to connect local nodes and city nodes. It consists of a combination of microwave links with high gain antennas and redundant microwave hardware.

At times, several nodes may best be served in tandem, with certain nodes carrying internodal traffic through the use of drop and insert facilities and at other times, the city node may be centrally located so that internodal links will be in a spoke fashion radiating in several directions.

Six foot diameter antennas will be utilized in the internodal network. Higher gains will ensure an adequate fade margin for the longer paths at the same transmitter power as the subscriber stations. Improved antenna sidelobe discrimination and back to front ratios will ensure maximum reuse of internodal frequencies, and should enable at least four internodal routes to converage on a single city node using a single frequency pair.

XTEN SERVICE FEATURES

Users of the XTEN system will be interested not in the technical workings of the network but rather in the service offerings which can give the best performance for their needs at a price which they can afford. The service features which XTEN will offer are identical to those offered on message switching networks.

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[13] *Ibid.* p. 35.

They are:

Store and Forward Service

XTEN as a packet switching network will fully buffer all message traffic, allowing input to take place at any time and holding output until the receiving device is ready.

Priority Control

Message priorities will be established so that high priority traffic is delivered rapidly. XTEN will offer transmission priorities ranging from within minutes to overnight.

Multiple Distributions

With a single entry of repetitive information, XTEN will accomplish distribution to multiple addresses. For repetitive distributions, users need identify only a particular distribution list rather than entering name and address information for each recipient.

Transparent Pipeline Service

For some purposes, such as distributed processing and remote job entry, users require a direct logical connection between terminals. This will be provided, by XTEN, on a virtual circuit basis, accomodating widely used protocols.

Security

XTEN will use modern encryption techniques. Password access and subscriber encryption of messages will also be available as an option. (Security is addressed in more detail in Chapter 6).

Message Accountability

XTEN will provide audit trails. Missing documents will be retrievable (time basis limited) from logs maintained at the control centers.

Device Compatibility

Speed, protocol, and encoding conversion will be provided.

Interconnection

Standardized interconnection arrangements will be offered for terminal devices of competing manufacturers. (A more detailed listing of features is contained in Appendix B).

CHAPTER III

PROBLEMS OF EXISTING SYSTEMS

> Historians credit the availability of efficient canals and highways as a major contribution to the Industrial Revolution. Accordingly, for the post-industrial, or Information Age to flourish, it seems we will need data arteries far superior to our present-day communications facilities, which tend to impede rather than expedite information flow.[1]

The office today is an economic frontier. Productivity has risen just four percent over the past decade, compared to a 90 percent jump in industrial productivity.[2] The lack of office information is believed by many to be the primary reason for this existing problem. Fortunately with the capabilities of such technologies as fiber optics, communications satellites, computers and digital technology in general, the potential exists for providing the required communications resources[3] to meet this problem.

According to the Xerox Corporation, three communications service offerings have been stunted in growth by existing communications facilities. They are, document distribution, data communications, and teleconferencing. This chapter will explore these three areas.

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[1] "Innovative Services Pave Way for Info Age of 80's", Communications News, (April, 1979) p. 38.

[2] "Automated Office Adds Muscle to White Collar Productivity Drive", Communications News, (May 1979) p. 70Z.

[3] "Innovative Services Pave Way for Info Age of 80's", Communications News, (May 1979) p. 70A.

DOCUMENT DISTRIBUTION

Preparation and access time, that is, the time it takes to get a copy of a document to a user has been too great for document distribution to be used both effectively and efficiently.[4] Building document distribution equipment and systems that are responsive to users needs. will make these systems a vital element in the office of the future.

It is obvious that future efficient document distribution systems will depend on the evolution of two particular, now practiced, methods of electronic document distribution: Facsimile machines and communicating word processors.

Facsimile has been a practical means of communication since the turn of the century, but has been used in only specialized applications.[5] It is an electronic communications process which permits exact copies of written, printed, and pictorial information to be sent and received over the telephone lines by compatible facsimile machines.

As early as 1937 a newspaper had been successfully delivered by radio facsimile-first by station KSTP in St. Paul, Minnesota, and then by WOR in New York. However, facsimile did not catch on, for in the meantime, upon the scene had come a rival with greater

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[4]"Micrographics in the Office of the Future", Journal of Micrographics, Vol. 12, No. 2, (Nov./Dec. 78), p. 86/62.

[5]B.G. Smale, High Speed Digital Facsimile Machines, 1976 International Conference on Communications Equipment and Systems, p. 174.

appeal: commercial TV.[6]

Predictions were made however that facsimile would become a universal communications tool,but only recently, since moving into the general office environment, has it shown signs of doing this.[7] This slow growth can be attributed to technological limitations and AT&T's earlier interconnect policies.

Technological advancements today have now made it possible to make facsimile machines relatively cheap, compact, and convenient for office use, but still there exist other obstacles to its growth.

Specifically they are plagued with the problems of slow speed, high cost per copy, poor resolution, the need for constant operator involvement and incompatibility between different makes of machines.[8]

Excessively long transmission time has been one of the most annoying characteristics of facsimile equipment to date. These long transmission periods result in two difficulties; high cost per copy and low throughout capability. Most analog systems transmit an 8½ x 11 inch business letter in four to six minutes. Call charges for a transmission of this nature amounts to 72 cents for ¼ of a transmitted page at a standard rate.[9] Also only 10

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[6]Daniel M. Costigan, FAX-The Principles and Practice of Facsimile Communications, (Chilton Book Company, Philadelphia, 1971) p. 9.

[7]B.G. Smale, High Speed Digital Facsimile Machines, 1976 International Conference on Communications Equipment and Systems, p. 174.

[8]Ibid.

[9]Ibid.

copies per hour can be transmitted. This means that businesses will only use facsimile for urgent communications. Therefore an increase in speed will greatly increase facsimile use.

A second obstacle to greater use of facsimile transmission is poor copy quality. Copy quality can be viewed by two criteria: 1) line resolution, and 2) page appearance. Poor copy quality can be attributed to the limitations in the reprographic process and circuit degradation of the transmission media (telephone lines). The resolution of a standard facsimile transmission is satisfactory for about eight point type or larger (about what one would find on an ordinary typewritten page). Anything smaller than this would be difficult to read. Since small type is used in a great deal of printed material, materials of this kind cannot be successfully conveyed by a standard analog facsimile transmission.[10]

Page appearance is also a problem. Although some progress has been made in this area, it is at best of fair quality. Most machines operating today utilize paper which is gray, crinkly, limp, difficult to file, and aesthetically less than pleasing.

Many facsimile users, for the reasons stated above, usually mail a follow up copy as an extra precaution. This is also an added expense.

Most existing machines require operator assistance when transmitting and receiving. The time taken to transmit several documents at 6 minutes per page ties up a voice line for excessive time

[10]"Digital-FAX its Significance to the Military", Signal, January/February 1973) p. 24.

periods, increases communication line costs, and unduly occupies operator time. It can only be concluded from this that excessive labor costs are required for operating the equipment to transmit and receive letters and documents, and for monitoring machine performance.

Another factor which has also served to curtail the use of facsimile, has been the lack of compatibility between facsimile types.

Two machines may be defined as compatible only if the following conditions hold.

> The first machine will synchronize with the second whenever the operators or machines execute a pre-determined control sequence using suitable communications links.
>
> One machine will transmit data to the other machine in such a way that the receiver will create a size-for-size hard copy image of the original document congruent to and having the same sense as the original.[11]

It has become obvious to all users of document facsimile that compatibility of equipment is necessary for the growth of the industry. There is now intensive activity within the International Telegraph and Telephone Consultative Committee to possibly enhance compatibility in facsimile.

AT&T's earlier interconnect policies have done their share to thwart the development of communications equipment such as facsimile. Interconnection is a direct linkage of customer-owned and maintained equipment with the telephone network. AT&T's

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[11] Robert E. Krallinger, Evolution of a Standard for Business Facsimile, (1978 International Conference on Communications, V3) p. 48.1.1.

policy has been that:

> No equipment, apparatus, circuit or device not furnished by the telephone company should be attached to or connected with the facilities furnished by the telephone company whether physically, induction, or otherwise.[12]

AT&T insisted that the use of customer-owned equipment divides its responsibilities, degrades circuit quality and weakens repair and maintenance services.

Under these circumstances equipment manufacturers, not part of the AT&T family, would be reluctant to sink large sums of money into the development of new equipment which had to interconnect with telephone company facilities. However this attitude was soon to change.

On 27 June 1968 the Federal Communications Commission issued its Carterfone Decision. The Carterfone was a device which acoustically interconnected mobile radio systems to the telephone network. In the 1968 Carterfone decision, the Commission found: (a) that the Carterfone satisfied a deficiency in the communications area; (b) that there was no proven harm to the existing telephone system; and (c) that AT&T's tariffs prohibiting its use were unreasonable and unlawful within the meaning of Sections 201(b) and 202(a) of the Communications Act of 1934.[13] The

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[12] International Communications Association, Legal Aspects of Interconnection, p. 2.

[13] Committee on Commerce, Science, and Transportation, U.S. Senate, Domestic Telecommunications Common Carrier Policies, Serial No. 95-42, March 21 and 22, 1977, p. 100.

Commission's decision was not specifically directed at Carterfone but had a general application to the entire industry in an effort to extinguish the unlawful tariff imposed by AT&T.

As a result of this decision and other subsequent decisions by the FCC (Primary Instrument,[14] Bell Bill[15]), interconnection has now become a growing industry. Thus manufacturers are now willing to spend extensive amounts of money to develop new equipment to interconnect with telephone company facilities. This now takes us to the problems of word processors.

Word processing is a modern expression which covers the way in which office personnel compose letters of other documents, and have a perfect copy communicated to someone else.[16] Communicating word processors contain such features as keyboards, high speed printing equipment, memory, editing, and reformatting of documents in storage. The problem of word processing equipment is that of cost and inadequate communications capabilities. As an example of cost, Exxon's Qyx subsidiary offers intelligent typewriters in five models, starting with a base unit costing $1390 and offering

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[14] The Primary Instrument Concept, CC Docket No. 78-36, Defeated July 13, 1978.

[15] "AT&T's Bold Bid to Stifle Competitors", Business Week, (March 15, 1976), p. 82.

[16] Science and Invention, Volume 20, (H.S. Stuttman Co., Inc., New York, NY 1977) p. 2701.

512 bytes of memory but no communications capability.[17] The next level contains two mini-floppies storing 30 pages each and carrying a price tag of $7,750; communications can be added for an additional $500.[18]

The International Resource Development of New Canaan, Connecticut estimates that there are about 250,000 word processors, however only 20,000 are communicating word processors.[19]

The basic point to be made is that the potential of these systems for the improvement of office productivity is extremely significant. Suppliers are using facsimile and word processors as an entry point into the automated office, and are working to solve the inherent problems of these types of equipment. Facsimile machines suffer from slow speed, are expensive to operate and maintain and are incompatible with dissimilar equipment. This situation however is changing with the development of faster and less expensive units that meet international standards. Another solution which helps with this problem is the growing availability of transmission facilities capable of solving equipment incompatibilities.[20]

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[17]"Automated Office Adds Muscle to White Collar Productivity Drive", Communications News (May 1979) p. 72.

[18]Ibid.

[19]Ibid.

[20]Ibid.

As for word processors the major problems still are cost and inadequate communications capabilities,but there are encouraging signs that this is going to change.[21]

DATA COMMUNICATIONS

Data Communications is the movement of computer information to geographically separated locations over communication transmission links. It is a complex subject which involves a lot of people, companies, and equipment. This very complexity is probably the primary reason for the problems which now exist.

Computers are designed to handle digital data, but in analog transmission, which is in widespread use, digital data must be converted to analog signals for transmission over telephone company lines (Digital transmission links are now becoming available for data communication users). Control signals are needed for establishing and maintaining connections. This requires a line protocol acceptable to terminals, telephone equipment and computers.[22] Execution of the desired protocol wastes time and reduces line utilization. Error control must be used because of electrical disturbances on lines which create errors in messages. Also the speed with which computers can manipulate data characters is about 1000 times faster than the speed with which voice grade telephone lines

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[21]Ibid.

[22]Harry R. Karp, Basics of Data Communications (McGraw-Hill Inc., New York, NY, 1976) p. 3.

can transmit then.[23] There are, however, workable solutions to all of these problems, but neither users nor suppliers should feel content with the state of existing systems.[24]

Modems

Modulators-Demodulators (Modems) are used to interface terminal equipment with the telephone network. The major criteria for choosing modems are transmission rate, turn around time, permissible error rate, reliability, cost, and maintainability.

Digital data from a computer or terminal is represented in the form of DC signals. Telephone transmission lines are not capable of transmitting DC signals directly, therefore there must be a carrier for the DC signal. Converting a DC signal to tones for transmission is called modulation, and converting back to a DC signal is demodulation. The necessity for modulation arises because a communication system is designed to handle signals of a specific form; and if the signal does not have the proper form, it must be changed through modulation.[25] As a result of this limitation, the signal output by a terminal such as teletypewriter would be unrecognizable if transmitted directly without the use of modems.[26]

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[23] Ibid.

[24] Ibid.

[25] S.W. Maley, "Telecommunications Systems", Telecommunications: An Interdisciplinary Survey, Edited by L. Lewin, Artech House, Inc., 1979, p. 403.

[26] "Modems", Computer Communications, (IEEE, Inc., NY, 1974) p. 187.

Line Control Procedures

Line control procedures, or data link control (DLCS) are hardware and software protocols used to manage the transfer of data and control information between separated computing devices.[27] This exchange of information between send and receive equipment prior to message sending is sometimes called "handshaking" of link establishments. Data Link Controls also determine the direction of the initial transmission and the mode of operation.

An example of a line protocol is shown in Figure 3-1.[28] In this particular figure, a polling sequence is depicted and the line protocol procedures outlined. At the point where the computer polls terminal B, there are five line turn arounds until the end of message transmission.

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[27] "Line Control Procedures", Computer Communications, (IEEE Inc., Ny. 1974) P. 212.

[28] Jerry Fitzgerald and Tom S. Eason, Fundamentals of Data Communications (John Wiley & Sons Inc., 1978) p. 100.

Figure 3-1

Steps	Central Computer Site		
1.	Poll Terminal A	→	
2.		←	Negative Response Code
3.	Poll Terminal B	→	
4.		←	Positive Response Code (Changes terminal mode from idle to text mode)
		←	Text (First block of text)
		←	End of Block Code
		←	Parity Check
5.	Parity Received Correctly	→	
6.		←	Text (Second block of text)
		←	End of Block Code
		←	Parity Check
7.	Parity Received Correctly	→	
8.		←	End of Message
9.	Poll Terminal C	→	
10.		←	Negative Response code

Figure 2-1: Line polling protocol

Each of these line turnarounds consumes time (modems/terminals typically requires 30 to 80 milliseconds and echo suppressors on voice grade lines require 150 to 300 milliseconds).[29] Therefore line protocols which can reduce the number of turnarounds are

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[29] Ibid.

highly desirable.

In existing telecommunications systems protocols are many, varied, and incompatible. Some in use today are Binary Synchronous Communications (BSC), Synchronous Data Link Control (SDLC, IBM's bit oriented data link controls protocol), High level Data Link Control (HDLC, ISO's bit oriented data link control), and Digital Data Communications Message Protocol (DDCMP). What is needed today in terms of protocols is a standard.

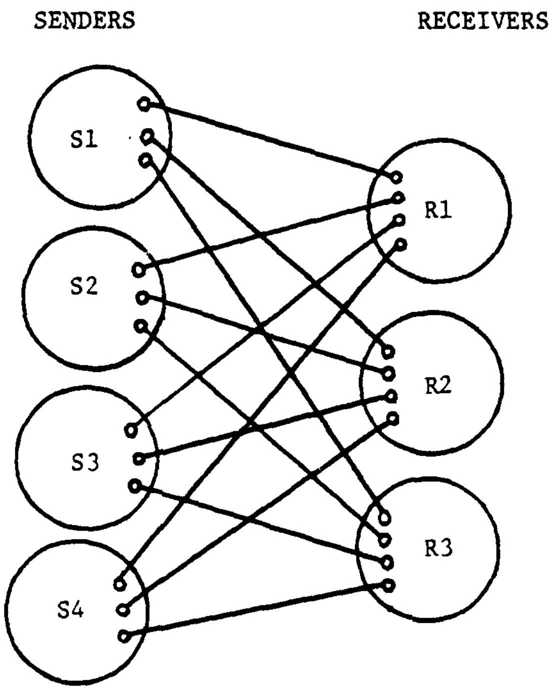
Standard protocols (see figures 3-2, 3-3,)[30] provide flexibility which can reduce system development time and maintenance effort and permits adaptation with requirement changes. Suppose N different information sources desire to communicate with M types of information receivers. Without a standard protocol, N times M ad Hoc protocols are required to satisfy all possible kinds of connections. The preferred method of achieving this interconnection is to introduce the standard protocol, necessitating only N + M implementations.

However, imperfections exist in standards. The existing standards developments have not been achieved without criticisms of various details. For example X.25 (a high level protocol designed to specify all interface standards for connecting terminals and computers to public data network operating in packet mode) has been criticized as too complex, fails to support datagrams, and

[30]John M. McQuillan and Vinton G. Cerg, Practical View of Computer Communication Protocols, (IEEE Computer Society, New York, 1978) p. 1.

duplicates functions at various levels.[31]

The main problem is that there are many non standard and incompatible systems which are and will be in existence for years to come; this would make adoption of an eventual standard difficult and costly, or a single company standard would be imposed on the industry through market power rather than technical effort.[32]



Ad Hoc Communication: 12 Different Protocols
24 Protocol Implementations

Figure 3-2 Protocols without standards.

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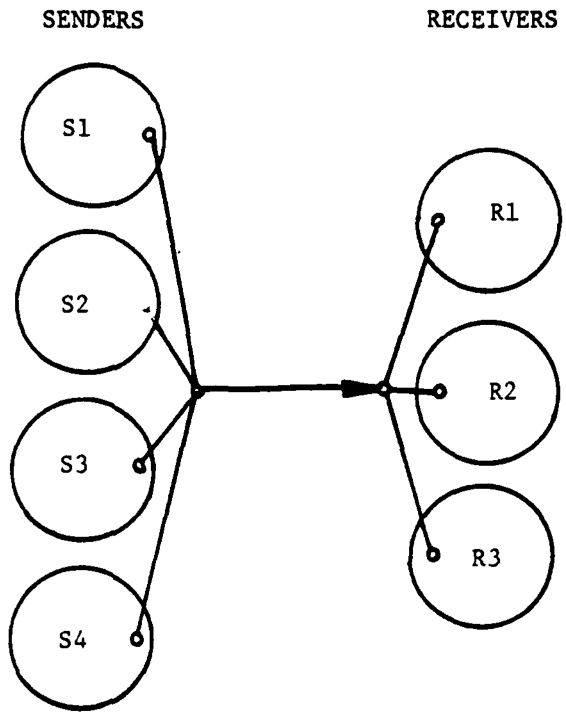
[31] Ira W. Cotton, Harold C. Folts, International Standards for Data Communications: A Status Report Fifth Data Communications Symposium, (IEEE, New York, 1977) p. 4-34.

[32] Ibid.



Communication using standard protocol: 1 Protocol
7 *Implementations*

Figure 3-3 A standard Protocol

Many different data controls could have an architecture designed to meet the basic requirements of today's telecommunication systems. However just meeting these basic requirements will not encompass all the various needs existing in today's data communication communities. What is needed is a data control architecture that meets the requirements of the largest possible set of communities and applications[33] or build telecommunication networks which will accomodate these non standard controls. With all things considered, the latter seems to be the appropriate solution.

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[33]Paul E. Green, Jr. Robert W. Lucky, Computer Communications (IEEE, Inc., 1974) p. 225.

Error Control

Communications links, specifically the telephone lines, have higher inherent error rates than computers and other electronic devices. Therefore it is necessary, in existing data communication systems, to use effective means of error detection and error correction. It is possible to develop data transmission codes which will give very high error detection and correction performance. To achieve correction and detection extra data must be sent, the more extra data sent, the more error protection. However, increased protection reduces transmission efficiency. Therefore, the efficiency of data throughout varies inversely as the desired amount of error detection and correction is increased.[34]

Future improvements provided data communications users, in terms of error protection, will rest on a joint effort by users, terminal equipment vendors, modem manufacturers, and the common carriers.[35] The best overall approach to error control for any application can only be obtained with a system design in which terminal equipment, modem, and communication links are treated as interacting subsystems.[36]

Telephone Links

In recent years, systems designers attempting to improve the

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[34]Jerry Fitzgerald and Tom S. Eason, Fundamentals of Data Communications (John Wiley & Sons, Inc., 1978) p. 114.

[35]Ibid. p. 302

[36]Ibid.

availability of data communication systems have become increasingly concerned with the telephone links as a viable transmission media.

John Spragins of Oregon State University at the 1978 International Conference on Communications talked about data transmission over the common carrier plant. A portion of his speech appears below:

> " The manner in which the telephone plant has been designed and installed influence the reliability of data communication systems utilizing telephone lines for communications. The telephone company utilizes two types of equipment: switching and transmission.
>
> Many different types of switching equipment are used in the telephone system, ranging from older switches such as panel switches and step-by-step switches to newer electronic switching offices. One of the major problems of older switches is impulse noise (this is any sudden excursion of the received signal beyond a certain amplitude level). An approximate breakdown of switching offices in the Bell System in 1971 showed 8600 step-by-step offices, 500 panel offices, 5700 cross bar offices, and 286 No. 1 ESS.[37] Newer equipment is being introduced by the telephone company, but older equipment is still common.

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[37] Also found in:
R.W. Lucky, "Common-Carrier Data Communications", Chapter 5 in <u>Computer-Communication Networks</u>, N. Abramson and F.F. Kuo (eds.), Prentice Hall, 1973, pp. 142-196.

Each telephone subscriber has his own local loop extending from his equipment to the switching office serving his location. Local loops represent the major investment of the telephone plant.

Although each subscriber has his own local loop, local loops may be the major single contributor to dependencies between failures in different lines. The reason for this is the telephone company's use of space division multiplexing. Failure in different communication lines tend to be highly correlated, since there is a tendency for different lines, especially if they are geographically close, to use considerable amounts of common equipment. In space division multiplexing many wire pairs share on large multipair cables. These cables are installed in radial patterns from switching offices. By splicing wires from the equipment of subscribers into the appropriate pairs in the cables, local loops are provided. This configuration indicates that, even if there is no obvious sharing of equipment among two or more locations in a computer communication system, it is possible for some multipair cables to be shared by local loops serving different locations. For centralized systems(i.e. multiple terminals accessing one central computer), the most likely location for a dependent failure is between the central system and the local switching office serving its location. One of Bell's recent manuals states, "true alternate routings cannot always be provided withoug new construction."

The functioning of data transmission systems will be impacted by telephone plant equipment reliability. This impact will be felt more heavily on systems with response time requirements which are stringent, where even short outages cannot be tolerated."[38] The establishment of a high speed digital communication system which does not use existing switching systems and telephone lines provided by the telco will address the basic cause of the problems mentioned above. (i.e. use of a network designed to carry voice conversations).

TELECONFERENCING

The term teleconferencing refers to the use of audio, video, and graphic communication techniques to enable meetings to be held among geographically separated participants.

Interest in teleconferencing has grown steadily in recent years because of the serious energy crisis the United States is encountering. As energy and labor costs continue to rise, it is evident that alternative methods to travel must be found.

A "live" video image is expensive because it requires the transmission of a lot of information which must constantly be revised to allow for movement. This means that the bandwidth must be very large (6MHZ) to accomodate all of this continuously moving information.

The cost associated with such a system is phenomenal. Video teleconferencing costs are in the neighborhood of $6.50 per minute

[38] John Spragins "Data Transmission Over the Common Carrier Telephone Plant: Factors Affecting its Reliability", IEEE 1978 Communications Conference, IEEE, 1978, p. 3.1.1.

from San Francisco to New York or Washington, $4.50 from Chicago to New York, $3.50 from Chicago to Washington, and $2.50 from New York to Washington.[39] Cost figures of this nature are an obvious inhibitor to the usage of such systems.

To offer some insight as to how teleconferencing systems have functioned in the past, let's look at some systems which are in use now or were in use at one time.

Bankers Trust Company (United States, two-site, discontinued). This sytem had two conference locations. It operated between 1963 and 1968, when it was determined to be too costly.

Bell Canada (Canada, two site, operational). This system has four studios. At present only two site connections are possible, although simultaneous conferences among two pairs of studios can be supported. An evaluation of this system through questionnaire indicated a high level of satisfaction among users. A market study indicated that users were concerned over confidentiality and overall picture quality.

First National City Bank (United States, two-site, discontinued). In the early sixties, this bank moved key executives to a new location within New York City and felt it was critical to retain immediate access to the Wall Street Office. This system was one of the earliest attempts at video conferencing. It was finally abandoned due to high costs even though the system was used regularly.

New York Metropolitan Regional Council (United States, multi-site, operational). This system, known as MRC, was revealed in 1969 but did not become operational until 1974. The system was well received. Most programming is in the Broadcast mode, originating from the World Trade Center Headquarters. There have been problems related to back up systems,split screen effects, and transmission of visual aids.

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[39] Robert Johansen, Jacques Vallee, Kathleen Spangler, Gary B. Shirts, <u>The Camelia Report: A study of Technical Alternatives and Social Choices in Teleconferencing,</u> 1977, p. 5.

Nippon Telephone and Telegraph (Japan, two-site, operational) Commercial service began in 1976 between Tokyo and Osaka. The rate charge for use of the system is $400/hour.[40]

The systems listed above are just a representative showing of the many teleconferencing systems simply to reflect on some of the problems which have been encountered. It appears that these systems are extremely expensive to operate, require considerable amounts of bandwidth, and are sometimes unable to display an adequate picture.

As an alternative to these existing systems XTEN will offer a slow scan teleconferencing system. Slow scan teleconferencing is a narrow band system which utilizes slow scanning rates and slightly long readout times to provide good definition in picture.[41] Xerox developed its slow scanning system based on the assumptions that:

1. Business concerns are more interested in a high resolution system which will transmit high quality text and graphics.
2. The use of full motion video is rarely cost effective in light of the bandwidth required.
3. Means for obtaining high-speed, high quality hard copy on demand has generally been non existant.

The National Aeronautics and Space Administration Network, probably the most successful application of teleconferencing to

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[40] Ibid. p. 151.

[41] Dave Ingram. The Complete Handbook of Slow-Scan TV. (Tab Books, 1977) p.12.

date, uses audio and high speed facsimile exclusively. It was first established during the Apollo moon landing program to speed up information exchanges between the Ames Research Center in California, the Goodard Space Flight Center in Maryland and the Lewis Research Center in Ohio.

XTEN, as an EMS network, and in light of the problems of some existing teleconferencing systems, is an alternative which should be explored by companies in the market. According to Xerox it is a system which can stimulate the introduction of efficient terminal devices which will permit the use of slides, transparencies, blackboards, and oral discussion; items which are prominent in business meetings today.[42]

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[42] Xerox's Petition, p. 16.

CHAPTER IV

SYSTEMS COMPARISON

Innovation is the process that begins with an inventor's insight and ends with a new product or technique.[1] Lately there has been some concern over America's apparent lead in innovation; it appears that this lead may be shrinking at an alarming rate. However, to date America still leads the world in innovative services. Inventions such as the transistor, the laser, and the semiconductor were all created in the United States and it was Yankee ingenuity that gave the world Xerography and instant photography.[2]

Telecommunication users in the United States will be able to choose among a broader range of network services to meet their voice, video, and data communications needs.[3] There is currently extensive activity in several leading firms towards packing technological advances into integrated networks which will employ the latest transmission and switching technology, specifically tailored

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[1] "Innovation, Has American Lost Its Edge", Newsweek, (Newsweek, Inc., New York, 1979) p. 58.

[2] Ibid.

[3] Winston E. Himsworth, Networks: "No Missing Links", Datamation (May 25, 1979, p. 107.

for data communications.[4] Three networks which should be available in the next two years, if not delayed by regulatory problems are:

ACS-Advanced Communication Service, a data communications network proposed by AT&T.

SBS-Satellite Business Systems, a total communications service network being developed by the partnership company of IBM, Comsat, and Aetna Life and Casualty.

XTEN-Xerox Telecommunications Network, an electronic message service proposed by the Xerox Corporation.

In assessing the likely impact of these three new networks it is good to view them together pointing out their similarities and relationships to each other and to other network services which exist today.[5]

AT&T's Advanced Communications Service is a shared, switched data communications network service. It integrates computers into a communications network to give users added flexibility in implementing data communication systems, compatibility for dissimilar equipment, customer control (by enabling him to define his own virtual subnetwork), and low entry threshold through the process of allowing a gradual phasing of applications into ACS. SBS and Xerox will both use satellites to provide switched, high speed digital

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[4]Ira W. Cotton, Harold C. Folts, International Standards for Data Communications: A Status Report, Fifth Data Communications Symposium, IEEE, New York 1977, p. 4-30.

[5]Winston E. Himsworth, Networks: "No Missing Links", Datamation (May 25, 1979) p. 107.

service between user premises. SBS will locate earth station antennas on a subscribers rooftop or in his parking lot. Xerox, on the other hand, will use microwave links and switching nodes to get from a subscriber's premises to a regional earth station.

Advanced Communications Services

Figures 4-1 and 4-2 are diagrams of AT&T's ACS network.[6] ACS is an intelligent data network that will concentrate on traditional data communication applications, and at much slower speeds (9600Bps) than in either the SBS or XTEN networks, however ACS can offer some capability for speeds to 56kbps.[7]

Initially, the ACS network will be implemented by using minicomputers at network nodes, which will control access, provide data switching, routing, and message management, interconnected by 56 kb/s trunks using existing AT&T intercity digital facilities.

Each node will be connected to every other node by at least two disjoint paths, and as the network grows, another level of nodes will be added to the hierarchy by geographical regions to perform tandem switching functions.[8]

ACS will be offering services such as speed and code conversion to support a variety of terminals(initially some 450

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[6]"ACS: Data Comm service", Data Management (January 1979) p.16.

[7]Winston E. Himsworth, Networks: "No Missing Links", Datamation, (May 25, 1979) p. 110.

[8]Morris Edwards, Innovative Services Pave Way for Info Age of 80's., Communications News (April 1979), p. 41.

ACS Network (Example)

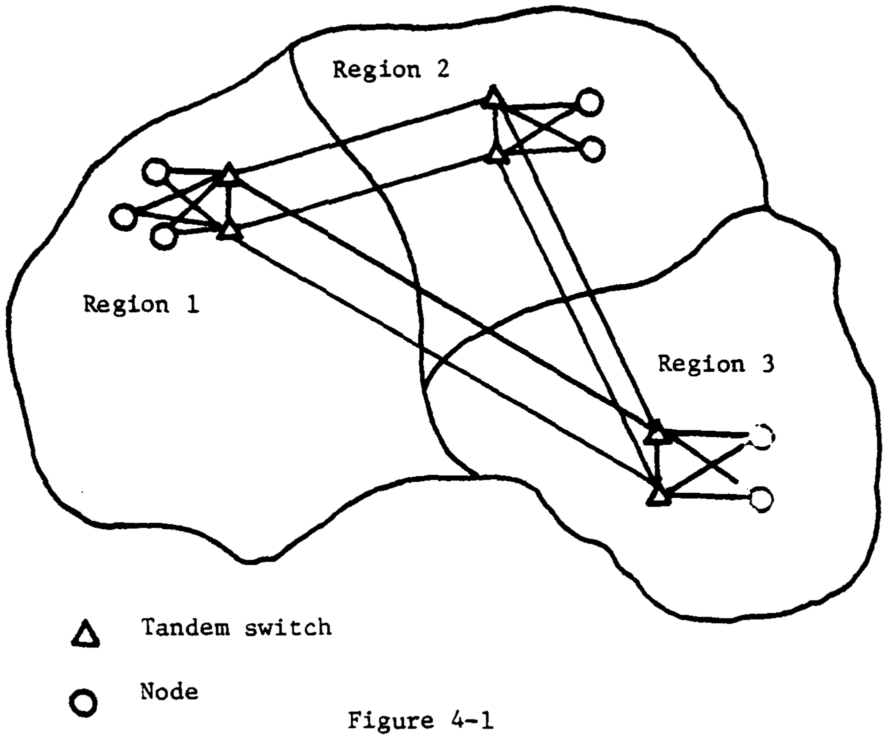

Figure 4-1

Functional Network Layout

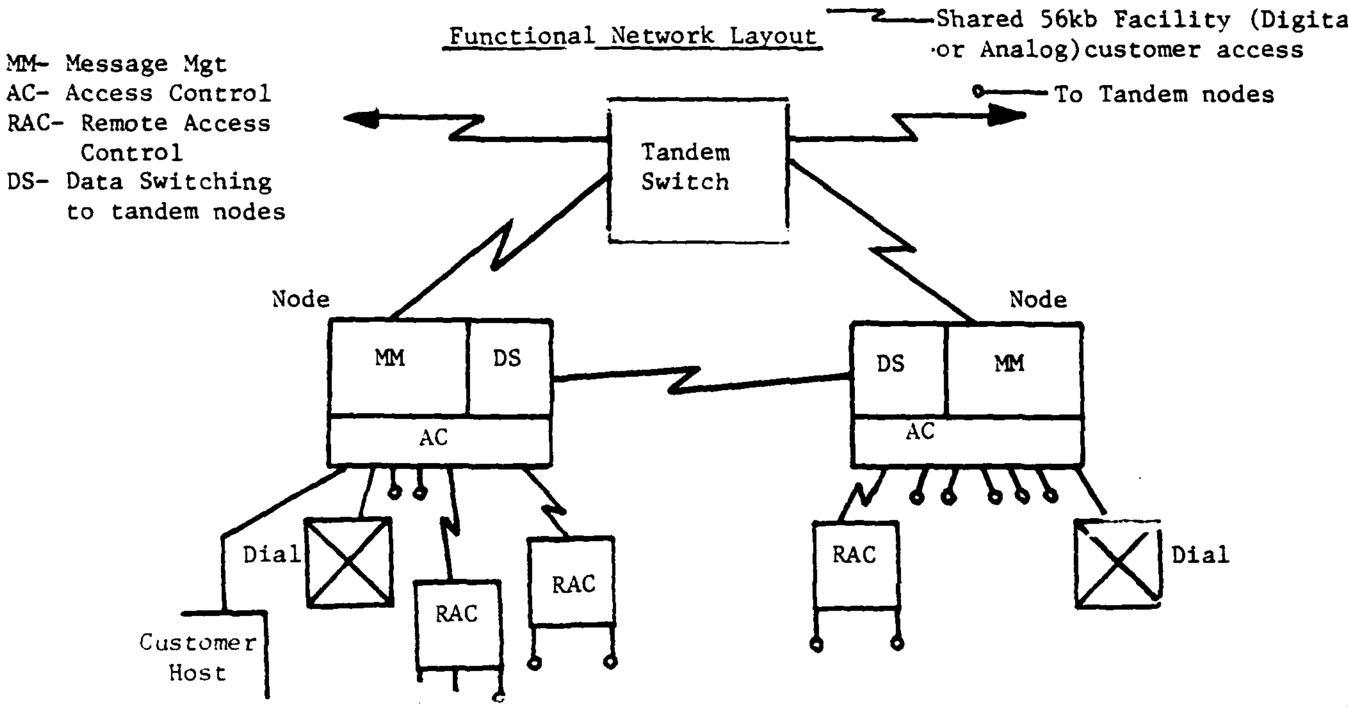

Figure 4-2

different types).[9] ACS will provide store and forward functions, flexible addressing and customer control. ACS is supposedly aimed at a broad base of potential customers, large and small data users alike.

But, will the smaller company or the first time data user be the real customer for ACS? The Yankee Group report doubts that conclusion.[10] It states its belief that ACS is aimed directly at the largest present-day data communications users because the 750 largest users account for 80% of all data communications, and:

1. They have sophistication and applications now.
2. AT&T's marketing push for ACS has been towards the largest users.
3. AT&T's marketing teams have been observed in contact with distribution, retail, and insurance firms-all large-account oriented.

Satellite Business Systems

According to Winston E. Himsworth,[11] "Satellite Business System's integrated network (figure 4-3) represent the most ambitious and, from a business viewpoint, the most risky of all three systems."

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[9]Winston E. Himsworth, Networks: "No Missing Links", Datamation, (May 25, 1979) p. 110.

[10]C.E. White, AT&T's ACS: a giant struggles for its bits, Telecommunications (February 1979) p. 25.

[11]Winston E. Himsworth, Networks: "No Missing Links", Datamation, (May 25, 1979) p. 110.

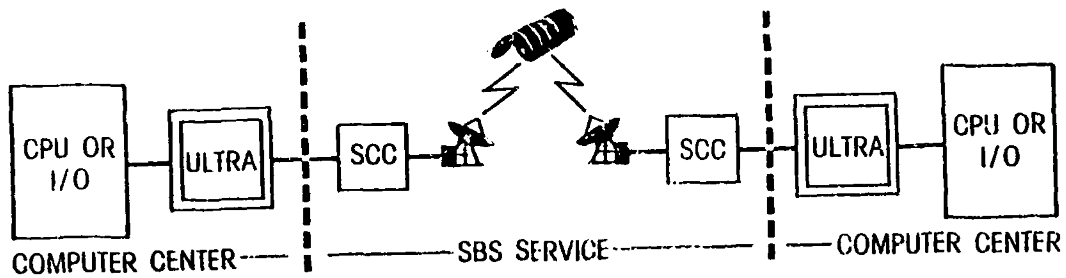

Figure 4-3 Through the ultra-high-speed data-exchange controller, users will be able to transmit from computer to computer at rates to 6.3 Mbps, making practical DP load leveling and resource sharing on a dynamic and organization-wide basis.

SBS is designed to provide users with integrated voice, data and image transmission capability. SBS plans to use satellite transmission with earth stations on their customer's premises. These earth stations may not be inexpensive nor small. They will employ 5 and 7 meter diamter antennas and, along with related communication integrating electronics will likely cost in excess of \$500,000.[12]

SBS will operate two in-orbit satellites with ten transponders each with each transponder on a single satellite having a capacity of 43Mbps or an equivalent useful capacity of 12,000 voice circuits.[13]

The all digital system is to operate in the 11.7 to 12.2 GHz band for satellite to ground transmission and 14 to 14.5 GHz for Ground to Satellite.

SBS will utilize two ultra-high-speed data exchange controllers for linking geographically separated main frame computers. The controllers will allow computer data to be transmitted without changing existing software, and at data rates up to 6.5 million bits per second between any two SBS customer network nodes.[14]

The telephone network is subject to usage fluctuations, a direct result of business calling patterns. Figure 4-4 reflects

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[12] Ibid.

[13] Morris Edwards, Innovative Services Pave Way for Info Age of 80's., Communication News (April 1979) p. 42.

[14] Ibid. p. 44.

what system loading often resembles.[15] These involve morning and after-noon peaks, and virtually no usage outside the normal business day.

SBS' main objective is to build a network aimed at specific customers and specific applications for the purpose of filling in the usage valleys with high speed data, facsimile, and teleconferencing as reflected in figure 4-5.[16]

The SBS system is designed for the large user; large government and commercial organizations with heavy traffic loads among multiple, geographically separated facilities. Not surprisingly, those coveted top 200 or so companies are the cream of IBM's (and AT&T's) existing business.[17]

XTEN

Like SBS, XTEN (explained earlier in more detail) is a satellite-based system which is primarily an Electronic Message Service. However, it is also designed to handle high speed data to provide such functions as document distribution, data transmission and slow scan teleconferencing.

The transmission path goes from a user station operating at up to 256 kbps through an interface to a rooftop transceiver. Transmission then proceeds to a local or city node utilizing frequencies in the 10.55 to 10.68 GHz band. Nodes will provide intercity service via the satellite.

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[15] Winston E. Himsworth, Networks: "No Missing Links", Datamation, (May 25, 1979), p. 108.

[16] Ibid.

[17] Ibid.

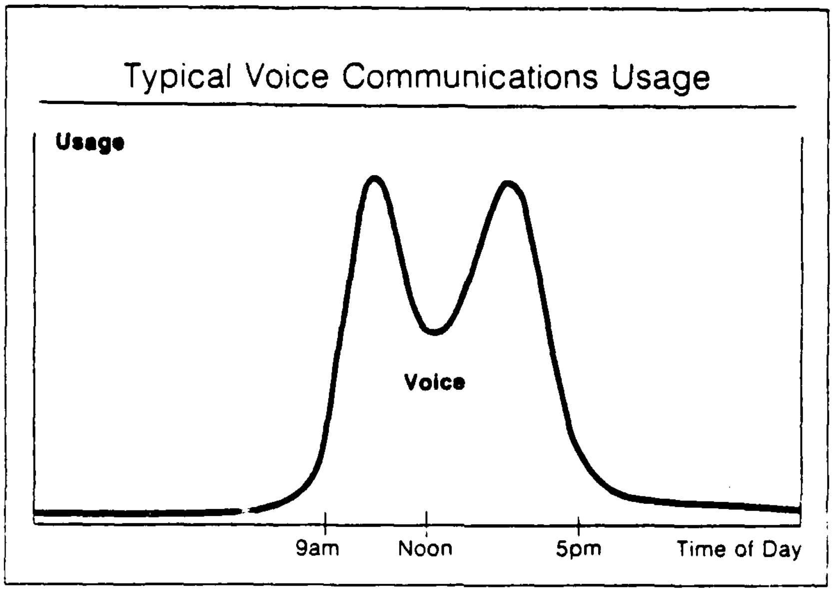

Figure 4-4

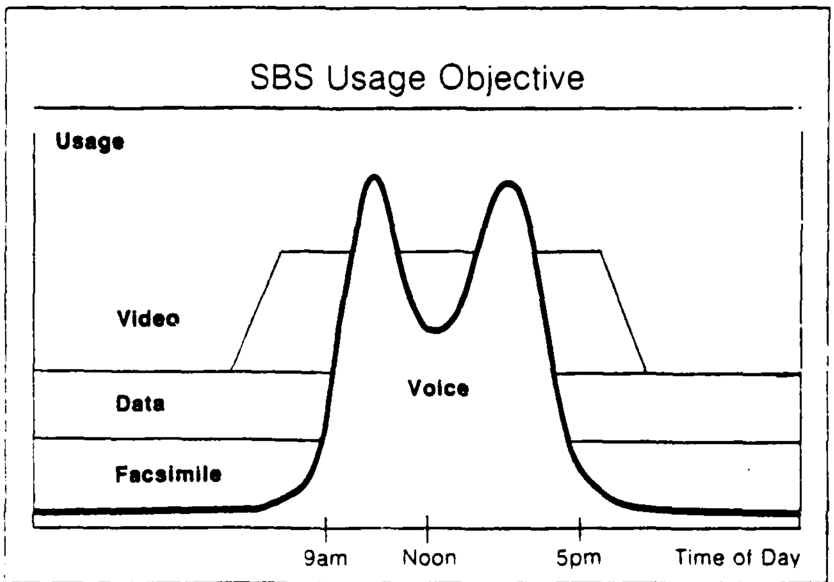

Figure 4-5

XTEN is aimed at a broader market than SBS. In Xerox's market survey it was concluded that there are several thousand enterprises, for which an EMS would offer benefits, with 20 or more individual locations. Almost 900 of these prospective customers currently have fifty or more domestic locations. The XTEN system is city oriented while the SBS system is customer oriented.[18] SBS does not have to concern itself with what city a customer is in because individual earth terminals will be located on user premises. XTEN, on the other hand, plans to put one earth station each in the largest 200 cities and distribute locally with terrestial microwave. Terminals associated with XTEN will be much less expensive (several thousand dollars versus several hundred thousand) and geared to a broader market.[19]

The Xerox study also pointed out that of the multilocation companies, 80% had 50 or less employees. That means that there is probably not enough communication traffic to justify the purchase of a very expensive SBS terminal.[20] However there is one major distinction with SBS which may favor it over XTEN. SBS is a total communication system. That is, it will allow you to totally integrate voice, data and image transmission. Whereas XTEN cannot provide voice, except digitized voice for teleconferencing, at its

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[18] Ibid. p. 110.

[19] Ibid.

[20] Ibid.

speeds. Therefore if an organization is looking to reduce total communication cost and further increase network efficiency, the more expensive SBS terminal may be more attractive provided the organization is financially able.

ACS, SBS and XTEN are three network offerings which can be expected in the future, however companies who need data communications services to carry out their business cannot and should not wait for these offerings. Users should not disregard the many network services which can today handle their voice, video, and data requirements.

American Satellite Corporation already has customers utilizing rooftop-to-rooftop networks for voice and high speed data. Western Bancorp has contracted with American Satellite to replace its terrestial links with rooftop and parking lot antennas to transmit digitized voice and high speed data between four of its major computer centers.

The telephone message toll network is being enhanced with electronic switching and digital transmission facilities.[21] It is already larger than any of the proposed networks.

Intelligent network services like Telenet and Tymnet are providing data communication and facsimile services.

Telenet is a multi-level hierarchial network consisting of a high-speed backbone network and local distribution networks. Long haul transmission of data is provided by the backbone

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[21] Ibid. p. 107.

network which operates at the speed of 56 Kbps.[22] Each node functions independently of the rest of the network and is interconnected to at least three other nodes. Each node forms the hub of the local distribution network which links intelligent concentrators in outlying cities via one or more access lines at speeds up to 9.6 Kbps.[23]

Tymnet was implemented in 1971 as a backbone communications system to meet the communication needs of low speed (1200 bps and below) data terminals linked to remote computers. Access to the network is provided through 400 intelligent communications processors via a local phone call from over 165 areas of the United States.[24]

To provide services that fully meet the needs of low speed terminals, Tymnet, according to the Tymshare Corporation, offers state-of-the-art message switching service that allows dissimilar terminals to communicate with each other. Tymnet will offer such services as on-line retention of recent messages, on-line storage for commonly used message data, terminal independence and low cost.[25]

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[22] Telenet Communications Corporation Brochure, p. 6.

[23] Ibid.

[24] Tymnet profile advertisement, Nationwide Packet Network Makes All Systems Compatible. Issued May 12, 1979.

[25] Tymnet, Inc., Brochure.

Multi-point Distribution Service (MDS) is an omni-directional, 6 MHZ radio transmission service licensed in some 100 cities. It is primarily used for pay television, however it can provide services similar to what XTEN proposes.

"Historically, users have tended to develop and use data communication systems to solve one business problem or application at a time, thereby creating a multiplicity of single-application networks."[26]

General Motors has 29 different and distinct major networks and Ford has six different networks emanating from the same building.[27] However, today businesses are beginning to consolidate their single-application networks.

The integrated network approach seems to be the wave of the future. Whether users consolidate or create their own systems for consolidating voice, data, image and message requirements, or buy these network service offerings from AT&T, SBS, or Xerox, it seems inevitable that, according to some industry officials, data communications is going to be absorbed into a communications melting pot.[28]

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[26]"FCC and Users Waiting for More Light to be shed on Bell's ACS", Communications News, (December 1978) p. 38.

[27]Howard Anderson, "A Look at the impact of Bell's ACS", Communication News (December 1978) p. 7.

[28]Dr. William A. Saxton, "Lots of Industry Signals in Xerox Netowrk Proposal", Communication News (January 1979) p. 57.

CHAPTER V

APPLICATIONS

XTEN as described and designed by Xerox is aimed at a broad market, however it is obvious that not all organizations may be deemed potential subscribers. Xerox in its market projections limited the spectrum of subscribers to those which:

A. Have substantial requirements for communicating with other establishments, (i.e. either members of their own organization) or those related to them in some other way (e.g., as a vendor or customer); and

B. Are large enough in size to justify installing the required communications equipment.[1]

The breakdown for potential subscribers, as presented by Xerox includes most leading U.S. corporations, plus:

A. 62 companies with annual revenues of less than $100 million

B. 207 companies with annual revenues of less than $250 million

C. Several Federal and State government agencies.[2]

In determining the applications of XTEN to organizations, it is good first to consider the way organizations have served their telecommunications needs in the past.

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[1] Xerox Corporation Petition for Rulemaking (November 16,1978), p. 1G.

[2] _Ibid._ p. 4c.

Communications users have for years built their own data networks using a wide spectrum of multiplexing and concentrating equipment.[3] As was stated earlier in chapter three organizations have tended to design separate systems to serve different applications. This has not always been very cost effective. But now it appears that with the move to the information age, emphasis is being placed on systems which are efficient, save energy, and are significantly cheaper to operate. With this in mind businesses are now consolidating their various nets to get better office productivity.

For some organizations, there will be a significant advantage in integrating voice, message, data, and facsimile requirements.[4]

1. After business hours voice circuits will not be utilized, therefore they can be used for data, message, and facsimile.
2. The integration of voice, message, and data, will allow users to reduce the number of facilities and still get the same grade of service.
3. Individual networks may not justify the economics of a leased circuit, but an integrated one might.
4. Integrated networks will facilitate the use of new service offerings when made available.

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[3] Winston E. Himsworth, "Networks: No Missing Links", Datamation, May 25, 1979, p. 107.

[4] Howard Frank, Network Analysis Corporation, Data Communication, (September 1978) p. 57.

With what is taking place in the business arena today, XTEN can be used by industrial organizations and can provide them with capabilities to perform in a more efficient and less costly environment. That is if their organization has a requirement for services such as data communications, teleconferencing, or document distribution and fit into Xerox's market structure, then the application potential is great and is there for the asking. However in applying XTEN to the Federal Government this straightforward application requires more discussion.

Federal Government

There exist two distinct classes within the Federal Government, military and non-military. The non-military class has 12 major data communications networks in existence today as shown in Table 4-1.[5] Close examination of this chart shows that the organizations listed fit Xerox's market structure in that they have substantial geographically separated locations. Therefore their requirements could be satisfied through XTEN.

The Automatic Data Processing and Telecommunications manager for the federal government is in Automated Data and Telecommunications Services. This office is located within the General Services Administration. Their goal is to encourage the application of information technology such that operating effectiveness is improved, cost reductions take place, government productivity is

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[5] C.E. White, "Government and Government Sponsored Data Networks", Telecommunications (June 1977) p. 21.

TABLE 5-1

MAJOR U.S. GOVERNMENT DATA COMMUNICATIONS NETWORKS
(NON-MILITARY)

Agency	Use	Further Information
1. Agriculture Dept.	Resource Sharing Computer Network	Wide-Band Terminal Net 5 19.6 kbps Lines Interconnects 4 Major Computing Centers
2. Atomic Energy Commission	Data Communications and Message Switching	33 Stations 1 Store-and-Forward Node
3. FBI - National Crime Information Center	Data Retrieval	90 Agencies on Net IBM 360/65 Central Data Store
4. Federal Aviation Agency (DOT)	Message Switching and Data Communications	7 Processors/1 EM Switch 3 Nets: Int'l, Domestic Flights + Administration
5. Federal Reserve System	Message and Data Communications	40 FRS Banks 143 Terminals Expanding Net for Data and Computer/Computer Communications
6. GSA's ARS	Common User-Circuit and Message Switching	2050 Subscriber Stations 3 Message + 24 Circuit Switching Offices 4000 Station Capacity 26 Agencies/Bureaus Use
7. Justice Telecom System	Message and Data Switching	200 Stations
8. NASA	Computer/Computer Communication Net	6 Major Switches 3M Circuit Miles Low, Medium High Speed Lines
9. National Weather Service (NOAA-Commerce)	Teletype and Facsimile	23 Sub-Nets 330 Weather Offices Integrated with FAA

Agency	Use	Further Information
10. Postal Services	On-Line Computer Communications	10k I/O Devices 5 Tele Concentrators + 2 ADP Centers 117 Large Post Offices
11. Social Security Administration	Real-Time Data Retrieval & Message Switching	463 Field Offices 771 Terminals Medium Speed Data Lines
12. State Department	Message Switching	200 Lines Secure Message Net

(Source: C.E. White, "Government & Government-Sponsored Data Networks," Telecommunications June 1977, p. 21.)

increased in a manner that will maximize the return of investment of United States tax dollars in automatic data processing and communications technology.[6]

In the June 1979 issue of Telecommunications Mr. Frank J. Carr, Commissioner, ADTS, gave his view of what he considered to be the government's telecommunications needs from civilian agencies.

The message inherent in this article was that: The government realizes that there is a convergence of ADP and communications technology taking place, and as a result of this it finds itself in the middle of the Information Age requirements. In order to meet these requirements some one billion dollars worth of goods and services will be procured from commercial vendors.

Although Mr. Carr realized the need for improved communication services, he also recognized that these services must be cost effective. In this regard the ADTS believed that even with the cost required to insure that privacy and security are protected, the best communication facilities for their purposes in the future are the shared facilities because of lower cost.[7]

The communications industry has historically played a key role in providing services to the government and will play an even greater role in the future. XTEN is no exception.

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[6]Frank J. Carr, "Government Telecommunications Needs for Civilian Agencies", Telecommunications (June 1978) p. 35.

[7]Ibid. p. 36.

MILITARY

Department of Defense Data Communications systems have special performance requirements which are perhaps more stringent than commercially available systems.[8]

Military networks can be divided into three categories, global-strategic, tactical, and non-tactical.[9] Each one of these categories has features designed to meet specific requirements. Examples in each category are given below.

Strategic Networks

The global-strategic Defense Communications System (DCS) is managed by the Defense Communications Agency (DCA). DCA was established on 12 May 1960 to provide direction and management control of long haul telecommunications for the Army, the Air Force, and the Navy. Components of the network include the Automatic Voice Network (AUTOVON), the Automatic Digital Network (AUTODIN) and the Automatic Secure Voice Network (AUTOSEVOCOM). There is a new component of this network which was developed by Western Union. It is AUTODIN II. Common transmission facilities, which include satellite links, high frequency and troposcatter radio links, line-of-sight microwave links, and terrestrial wire and coaxial cable links, are sometimes shared by these networks.[10] In addition to these networks, the DCS includes several special purpose networks.

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[8] R.F. Linfield, Control Signaling in a Military Switching Environment, NTIA Report 79-13 (January 1979) p. 52.

[9] Ibid.

[10] Ibid.

PWIN is an acronym for Prototype WWMCCS Intercomputer Network. WWMCCS is another acronym for World Wide Military Command and Control. It includes 35 medium and large scale computer systems and remote terminals at 26 locations. PWIN connects six WWMCCS sites together for command and control.

A two-way data network called SATIN IV for strategic Air Command Automated Total Information Network IV will be a Strategic Air Command (SAC) subsystem of WWMCCS. It will connect SAC headquarters to all SAC aircraft bases, missle combat crew commanders and other WWMCCS locations.

Tactical

Tactical communications for all military services are now being combined under a joint tactical communications program called TRI-TAC.[11] Under Tri-TAC each service branch (i.e. Army, Navy, Air Force), is responsible for designing certain components of the system. For example, the Army is responsible for developing a switch which incorporates both message and circuit switching capabilities.[12] This switch is designed to meet both tactical requirements and portions of the DCS strategic network.[13]

Non-tactical

Non-tactical communications networks serve individual military bases and are managed by each military department and the

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[11] Ibid. p. 53.

[12] Ibid.

[13] Ibid.

base commander.[14] These include such services as telephone, record and computer data, video imagery such as facsimile and television.[15]

Distinctive Characteristics

The special requirements of military networks distinguishes them considerably from commercially available networks. These systems must contain:[16]

(1) Secure and anti-jam links to ensure positive control and prevent unauthorized commands that could deny service;

(2) Secure telemetry links so that only authorized users can determine the health of a military satellite;

(3) Protected communications channels to sustain vital communications under jamming conditions;

(4) A rapid on-orbit repositioning capability to satisfy unique contingency operations; and

(5) Adequate safeguards to insure that a system cannnot be destroyed by physical attack.

Table 4-2 compares the behavior of commercial and military networks in terms of the above parameters.[17]

Military networks are subject to such actions as jamming and enemy action, which commercial networks are not designed for. The

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[14] Ibid.

[15] Ibid.

[16] Communications News (August 1978) p. 23.

[17] R.F. Linfield, Control Signaling in Military Switching Environment, NTIA Report 79-13 (January 1979) p. 56.

ability of a network to survive destructive forces determines its survivability. It is essential for the network to provide communications at all times. Distributed control, rather than centralized control, aids in survivability. Star networks and hierarchal structures with centralized control are undesirable.[18]

Military networks utilize multilevel security. This means securing information on several levels from unclassified through compartmented top secret with simultaneous access to the system (or network) by users with differing levels of security.[19]

A network must be available when it is required for use. When contention occurs, priorities are established ranging from routine to flash for message traffic and routine to flash override for voice traffic.

The foremost difference between these two distinct classes of networks falls under the heading of cost. The Department of Defense sees the DCS network as a revenue consumer whereas common carrier networks are revenue producers.[20] It is the common carriers position to sell as much service as possible to users of the network while DCS is designed to provide only the service required to meet military needs at minimum cost.[21]

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[18] Ibid. p. 57.

[19] H.F. Szempliski, "Security in ADP Network Systems", May 1977, p. 3.

[20] Roy Daniel Rosner, A digital data network Concept for the Defense Communications System, National Telecommunications Conference VII (IEEE 1973) p. 22c-1.

[21] Ibid.

Table 5-2 Comparison of Commercial and Military Networks

Characteristics	Commercial Networks	Military Networks
Survivability	Limited by economics	Extremely high Redeployment Adaptive routing
Availability	Priorities usually not assigned	Preemption priorities Require precedence Input and output alerts Low blocking Probability
Security and Privacy	Low level privacy for certain transactions only	Multi-level security required on all transactions
Reliability	Moderate MTTR	Low MTTR
Dynamics	Relatively stable traffic statistics Limited spare capacity	Large uncertain traffic statistics Spare capacity required for peaks
Adaptability	High inertia system, slow to adapt to changing environment and technology	High flexibility to suit military operations

Table 5-2 Continued

Characteristics	Commercial Networks	Military Networks
Compatibility	Interoperability dictated by economics	Interfacing required between tactical, non-tactical and strategic networks
Special Services	Limited to specific users	Unique military Required by many users
Access Area	Depends on loop and switch costs and terminal density	Depends on geographical layout
Cost	Networks implemented to produce revenue	Network cost to be minimized
Performance	Depends on markets	Depends on special military requirements

This point cannot be overemphasized. The DCS costs about 500 million per year to operate and another 400 million per year is used for new systems. The total figure is about 22% of the DOD expenditures for command, control and communications.[22]

The use of integrated networks like XTEN(pointing out advantages and disadvantages)has been under study for some time now -- Rosner in 1973,[23] Coviello and Vena in 1975[24] and Schutzer and Ricci in 1976.[25] The ARBITS and AFBITS programs evaluate the cost effectiveness of these networks for base communications.[26]

Obviously there are advantages to using integrated networks. The total cost of transmission may be reduced but it may only be economically achieved by sacrificing performance to certain users. The long range forecast of military networks calls for, in the non-tactical area, integrated voice, data and slow speed imagery,

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[22] J.H. Babcock, (1977) Defense Communications System Policy, fiscal guidelines and areas of future emphasis, Signal, p. 79-80.

[23] Roy Danial Rosner, A digital data network Concept for the Defense Communications Syste, National Telecommunications Conference VII (IEEE 1973) p. 22c-1.

[24] G. Coviello and P.A. Vena (1975), Integration of circuit/packet switching by a SENET concept, NTC, 3 New Orleans, La. p. 42-12 to 42-17.

[25] D.M. Schutzer and F.J. Ricci (1976), Design and Implementation of a PAC-switched network, trends and applications 1976: Computer Networks, Gaithersburg,MD. p. 182-186.

[26] R.F. Linfield, Control Signaling in a Military Switching Environment, NTIA Report 79-13 (January 1979) p. 78.

and separated video (TV not until the 1990's).[27] Because the military usually has requirements which are peculiar to the military environment, it is likely that commercial systems would have to be modified to meet these requirements.

CHAPTER VI

SECURITY

From the beginning of time man has considered using machines to make everyday work routines much easier. With the information age upon us, Electronic Data Processing has greatly increased man's ability to store, retrieve, manipulate and transmit vital information.[1] Along with the information age has come an ever increasing concern for better data security and privacy precautions. Why is there such concern for data security and privacy? Before this question can be answered, one must know what these two concepts mean and what their relationship is to each other.

Data Security and Privacy

Data communications systems are fast becoming the subject of, environment for and tools of criminal and other disputed acts. This is occuring as the transistion from manual to automated data communication systems takes place.[2] Data security, the preventive measure for these systems, refers to the protection of data against inadvertent compromise, unauthorized release, and unauthorized modification or destruction. Adequate discussion cannot be totally

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[1]Charles F. Hemphill Jr., John M. Hemphill, Security Procedures for computer systems. (Dow Jones-Irwin,Inc. Illinois, 1973) p. 1.

[2]Donn B. Parket, "The Nature of Computer-Related Crime, Computer Communications, (IEEE Inc., New York 1974) p. 47.

given to data security without giving at least lip service to computers first.

Computers represent the nerve center for most government and commercial organizations. Yet there is no single factor within these organizations that surpasses the computer in ability to virtually cripple or destroy them.[3]

The impact of computers on society can be compared to that of a nuclear physicist. Both can bring great rewards if applied to correct ends; if not, they can bring the world close to total destruction. It is the concentration of destructive power which makes nuclear weapons dangerous and it is the concentrative characteristics that exist within computers that make them a threat.[4]

The fact of the matter is that Americans have been thrust into an information-based arena that exhibits an increasing desire to collect and store information. Some of this information could potentially affect an individual's personal privacy. Large corporations and government organizations today are gearing up for the information age by obtaining large numbers of computers and interrelated equipment. But these organizations have always collected information, some of which has been of a confidential nature. However, in recent years the problem has received widespread attention because of the increasing use of computers, information systems,

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[3]Charles F. Hemphill, Jr. and John M. Hemphill, Security Procedures for Computer systems. (Dow Jones-Irwin, Inc. Illinois, 1973) P. 1.

[4]Peter Hamilton, Computer Security (Associated Business Programmes Ltd., London 1972) P. 9.

and telecommunications facilities.[5]

For example:

1. A corporation uses a real-time system for controlling many of its activities. So vital to the operation are the computer programs that the corporation could no longer function if they ceased to exist.

2. The clearing banks in London have computers that process checks totaling almost 100 million pounds a day. Changes in the programs could produce history's most profitable robbery.

3. Commercial data banks contain trade secrets and other information that could be worth millions of dollars to competitors. For example, the results of oil or mineral prospecting might be worth a great deal to a competitor.

4. A variety of nuclear weapons are under computer control. The decision to launch a defensive nuclear attack is made by men reacting quickly to information from computer systems.[6]

Computers and even the new integrated networks have not created a data security problem, but, they have enlarged the scope of information gathering. Increasing quantities of information can be gathered, recorded, and later retrieved at a moment's notice.[7] Evidence of this is pointed out in Dr. H.R.J. Gorsch's statement made in June 1974:

> We can store three trillion binary digits, a five hundred word dossier for every man, woman, and child in the United States, in a commercially available machine small enough to fit in an elevator...Only the enormous expense of setting up data

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[5]Harry Katzan, Jr. Computer Data Security, (Litton Educational Publishing, Inc., New York, 1973) p. 2.

[6]James Martin, Security, Accuracy and Privacy in Computer Systems, (Prentice Hall, Inc., Englewood Cliffs N.J., 1973) p. 3 to P. 4.

[7]Harry Katzan Jr., Computer Data Security (Litton Educational Publishing, Inc., New York, 1973) p. 2.

> banks in the first instance holds us back from recording everything about everybody and keeping it forever.[8]

This is where the problem lies. In past years physical barriers (vault doors, locks, etc.) provided all the security that was required. Their purpose was to make the unauthorized taking of information not worth the effort. However in modern telecommunications systems, access to the information is much easier whether authorized or unauthorized. This fact ushers in the concept of privacy.

We are currently able, by technological means, to effectively destroy one's privacy.[9] Privacy refers to the rights of individuals and organizations to determine for themselves when, how, and to what extent information about them is to be communicated to others.[10] Privacy of information is in its infant stages because most Americans have not considered the right to privacy a significant issue. They have been fairly confident that their private lives have been indeed private. Although, in modern terms, privacy of information is something new, the word privacy has been around for some time as related in history.

An 1890 Harvard Law Review article, written by Samuel Warren

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[8] Data Security and Data Processing, Vol. 3, Part I, "State of Illinois Executive Overview", IBM Corporation: White Plains, N.Y., 1974, p. 7.

[9] Lance J. Hoffman, Security and Privacy in Computer Systems (John Wiley & Sons Inc., 1973) p. 1.

[10] Alan F. Westin, Privacy and Freedom, New York, Atheneum, 1967, p. 7.

and Louis Brandeis (they both later became Supreme Court Justices), introduced a privacy law (Warren Brandeis, the Right to Privacy, 4 Harv. L. Rev. 193). The article was in response to what the two young lawyers considered prying and gossipy coverage by the Boston newspapers of the social affairs of the Warren family.[11] Warren and Branceis were prophetic in foreseeing that someday "mechanical devices would threaten to make good the prediction that what is whispered in the closet shall be proclaimed from the rooftop."[12] The problem today however is not mechanical devices but electronic.

Another case in history was in 1902, Roberson v. Rochester Folding Box Co., 171 N.Y. 538, 64 N.E. 442 (1902). A young girl who discovered her portrait on posters advertising flour in stores, on warehouse walls, and in saloons, learned that she had no legal recourse.[13] This case later prompted legislative action which gave rise to a New York statute in 1903 prohibiting such actions without written consent.

Today, the big problem is that while information technology is flourishing, the technological innovations to secure it are not. There are nearly 2000 types of U.S. government files holding personal information about individuals. However, only a third of these have some guarantee of confidentiality.[14] The number in the commercial

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[11]Donald M. Gilimor, Jerome A. Barron, Mass Communication Law (West Publishing Co., 1974) p. 287.

[12]Ibid.

[13]Ibid.

[14]James Martin, Security, Accuracy and Privacy in Computer Systems, (Prentice Hall, Inc., Englewood Cliffs, N.J., 1973) p. 2.

environment may be less.

"We are always working in a catch up mode." This statement was made by Edward H. Coughran, University of California, San Diego at a Honeywell Computer Security and Privacy Symposium in April of this year.[15] Robert E. Kurkrall, Honeywell Information Systems, at the same symposium said basically the same thing when he said, "The sophistication of current technology and the explosive growth in the number of systems contribute unique control and access problems. Unfortunately, audit and control criteria have not necessarily kept pace with the technological growth."

The reasons for the lack of adequate security measures for the protection of information are numerous. Some businesses continue to rely on the ignorance of outside individuals as the principle means of security. The believed complexity of EDP systems has done its share to hamper security. This attitude assumes that the very complexity of the operation will discourage any unauthorized tampering. Thinking of this kind ignores the purpose for which EDP systems were established, to do whatever the operator directs.[16] Perhaps the foremost reason is cost. Those few individuals who realize the danger in the lack of proper security measures are not the ones which control the finances of the organization. Therefore the people who do control the money must become computer people as

[15] Edith Myers, "Security - A game of Catch Up", Datamation (May 1979) p. 76.

[16] Charles F. Hemphill Jr., John M. Hemphill, Security Procedures for Computer Systems (Dow Jones-Irwin, Inc. Illinois, 1973) p. 3.

well and begin to understand the problem. Although there has been laxness in the providing of privacy measures, there have been some efforts to thwart these lagging measures as well.

In 1972 Elliot Richardson, who was then Secretary of Health, Education, and Welfare, created an advisory committee charged with the responsibility of analyzing the possible harmful consequences that might result from automated personal data systems. One of their proposals was that:

> Any organization creating, maintaining, using or disseminating records of identifiable personal data must assure the reliability of the data for their intended use and must take reasonable precautions to prevent misuse of the data.[17]

As can be seen it is recommended that Data security be given its greatest attention when an individual's privacy is jeopardized.

President Carter in April asked for legislation designed to protect an individual's privacy.[18] He also proposed new restrictions on the use of records both medical and those of financed research projects. He further promised to submit a bill that would expand privacy laws concerning banking, credit, and insurance records.[19]

U.S. Senator Abraham A. Ribicoff, (D., Conn.), is the author of a proposed Federal Computer Systems Protection Act which will

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[17]Kent S. Larsen, Privacy, A Public Concern, A resource document, Domestic Council Committee on the Right of Privacy and the Council of State Government. 1975, p. 113.

[18]Edith Myers, "Privacy Guidelines", Datamation, (May 1979) p. 79.

[19]Ibid.

make certain computer crimes federal offenses. Many feel that this bill will fill a void because computer crimes are the only potential criminal area not covered by law. However there are criticisms cf this bill.[20] It does not cover crimes of a lesser nature.

The Ribicoff bill would impose a severe penalty: 15 years or $50,000. Edward H. Coughran worries, hypothetically, that "It could cover not only actions but attempt. What if I access a University of Wisconsin computer via Telenet in the middle of another program being run and cause an abnormal abort. I could be eligible for 15 years in the slammer."[21]

It is obvious the bill has flaws and the Senate Committee on Government Affairs will be holding hearings to amend the bill.

Data security is a troublesome issue and to make matters worse it has to be related to the social issue of privacy which is itself both controbersial and emotional. Arthur R. Miller's summation of the situation is most appropriate:

> The new information technologies seem to have given birth to a new social virus - "Data-mania". Its symptoms are shortness of breath and heart palpitations when contemplating a new computer application, a feeling of possessiveness about information and a deep resentment toward those who won't yield it, a delusion that all information handlers can walk on water, and a highly advanced case of stigmatism that prevents the affected victim from perceiving anything but the intrinsic value of data. Fortunately, only some members of the information-handling fraternity have been striken by the disease.[22]

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[20] Ibid.

[21] Ibid.

[22] Arthur R. Miller, The Assault on Privacy, (University of Michigan Press, Ann Arbor, Michigan, 1971) p. 37.

The reason that a relationship exists between data security and privacy is that privacy is an integral part of society and affects the behavior of its members.[23] Perhaps, the most significant function served by privacy, from a data security standpoint, is that of a limited and protected communication which protects the individual against the disclosure of confidential information to unwanted parties.[24]

The point to be made is that the issues raised by the privacy concept should be taken into consideration when establishing an effective data security program for an information based operation. Even though information systems do not directly control the actions of individuals, effective measures can and should be developed such that protection of information files can be maximized.

With the onslaught of the value added networks (TYMNET, TELENET) and the new integrated networks (XTEN, SBS, ACS), there is even more reason to establish effective security measures.

Impact of Networks on Security

The new innovative networks which should be available in the 80's will connect large numbers of ADP systems of corporations and government organizations. They will increase the potential for interception of vital information by:

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[23] Harry Katzan, Jr., Computer Data Security (Litton Educational Publishing, Inc., New York, 1973) p. 2.

[24] Ibid. p. 3.

1. Greatly increasing the number of users with potential unauthorized access.

2. Potentially making the security controls on a specific host irrelevant when information is accessible to other hosts that do not have effective security controls.

3. Introducing additional vulnerabilities through the lack of effective security controls in network elements.[25]

Providing security for data communications networks is not simple, but can be accomplished if done in a systematic and careful manner.

Establishing a Secure Network

When networks which consist solely of secure computer systems become a reality, consideration must still be given to security mechanisms in the network itself.[26] The possibility that individual components of data communications networks could be physically attacked would violate the basic assumption on which secure computer systems (and therefore by extension) secure networks are based.[27]

Detailed information concerning the security architecture of the XTEN system was unobtainable because the system has not been approved by the Federal Communications Commission. However there are basic design principles and security measures which should be followed in the planning of any secure network and should apply to XTEN as well.

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[25] H.F. Szemplinski, "Security in ADP Network Systems" May 1977, p. 4.

[26] Stephen T. Kent, "Network Security: A Top Down View shows Problem", Data Communications (June 1978) p. 57.

[27] Ibid.

The basic requirement of a secure network is to provide a secure path to: assure that data which is transmitted over the network will be delivered only to the appropriate user, and prevent unauthorized access to the network itself and the data flowing through it. Meeting this basic requirement hinges on two logical tasks: [28]

1. Establishing the protected path
2. Protecting the protected path

Establishing the protected path

Establishing the protected path encompasses certain design principles which should be considered when the network is on the drawing board. This way frustrations and security violations will be held to the absolute minimum. The principles are, economy of mechanism, open design, separation of privilege, least privilege, least common mechanism, and psychological acceptability.[29]

"Economy of mechanism" requires the designer to design a network as simply as possible and still get the desired result. This is especially suitable in the development of the protection mechanisms because of the unwanted access paths which may result as a consequence of design and implementation errors. Since these types of faults will go unnoticed during normal use, other steps must be taken to ensure proper security. These steps usually

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[28] H.F. Szemplinski, "Security in ADP Network Systems" May 1977, p. 9.

[29] Stephen T. Kent, "Network security" a top down view shows problem", Data Communications (June 1978) p. 57.

include techniques such as line-by-line inspection of software and the physical examination of the hardware. If techniques of this sort are to be effective, then a small and simple design is mandatory.

The configuration of the protection mechanisms should not be classified. This is what is meant by "open design". Mechanisms should depend not on the ignorance of potential saboteurs but rather on more easily protected passwords and keys.

"Separation of privilege" is based on the assumption that a protection mechanism that required two keys is much healthier and more adaptable than a mechanism which requires one key.

The concept of "least privilege" requires that every program and every subscriber of a network be limited only to the privileges which will allow him to perform his function. In this respect the amount of damage from an accident, an error, or an attack will be limited.

The principle of "least common mechanism" implies that the quantity of mechanisms at the disposal of more than one subscriber (and also required by other subscribers) should be restricted to a minimum level. Every shared mechanism offers the potential for a security violation because they offer easy information paths between subscribers.

Finally the "psychological acceptability" principle stresses that the human interface must be human oriented. If the subscriber's mental image of his protection goals coincides with the mechanisms he must use, mistakes will be minimized.

Protecting the protected path

Protecting the protected paths breaks down into two categories: access control (fail safe defaults,[30] reference monitor[31]) and protected communication (links, nodes).

There are some one million people in the United States who are in jobs which involve computers in some manner.[32] As a result of this, there are increasing numbers of these people who require access and are doing so through the use of terminals (i.e.programming, airline reservation, stock broker etc.). With such numbers of people being able to access computers systems the problem of validating their right to access is now a concern and rightfully so. The issue of how much access security should be provided depends on the costs, risks, and benefits which may result.[33] Two means of data access control are fail safe defaults and reference monitors.

"Fail safe defaults" require that access decisions be based on permission rather than exclusion. This approach questions the accessibility of subscribers rather than why they should not have access.

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[30] Ibid.

[31] E.W. Berkheiser, P. C. Baker, R. Capaldo, Security Architecture for AUTODIN II, NTC 77, 3 IEEE NY., p. 37: 4-2.

[32] Ira W. Cotton, Paul Meissner, Approaches to Controlling Personal Access to Computer Terminals, Computer Networks - Trends and Applications IEEE 1975 p. 32.

[33] Dixon R. Doll, Data Communications (John Wiley and Sons New York, 1978) p. 410.

The reference monitor concept (Figure 6-1) arbitrates each reference made by each program in execution by checking attempted accesses against a list of authorized accesses for that subscriber.[34] It enforces a system-wide view of access control.[35]

To discuss protected communications, a network model will be used as an illustration. Since the XTEN system could possibly be packet switching, all information will be in relation to such a network. The encryption which will be used will be the National Bureau of Standard's data encryption standard because it is a publicly known algorithm.

The basic component of the network is the communications subnet (transmission medium) which is in this case microwave radio and satellite transmission links.

Network Model

The purpose of the subnet is to connect the user to the network (Fig 6-2)[36]. It begins at the user rooftop transceiver. To protect the integrity of the network there are two basic approaches to communications network security: link-oriented and end-to-end (Fig. 6-3).[37]

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[34] E.W. Berkheiser, P.C.Baker, R. Capaldo, Security Architecture for AUTODIN II, NTC 77, 3 IEEE NY., p. 37: 4-2.

[35] Stephen T. Kent, "Network Security: a top down view shows problem", Data Communications (June 1978) p. 58.

[36] Xerox's XTEN Brochure

[37] U.S. Dept. of Commerce, The Network Security Center: A System level approach to Computer Network Security. NBS Special Publication 500-21, V2, p. 23.

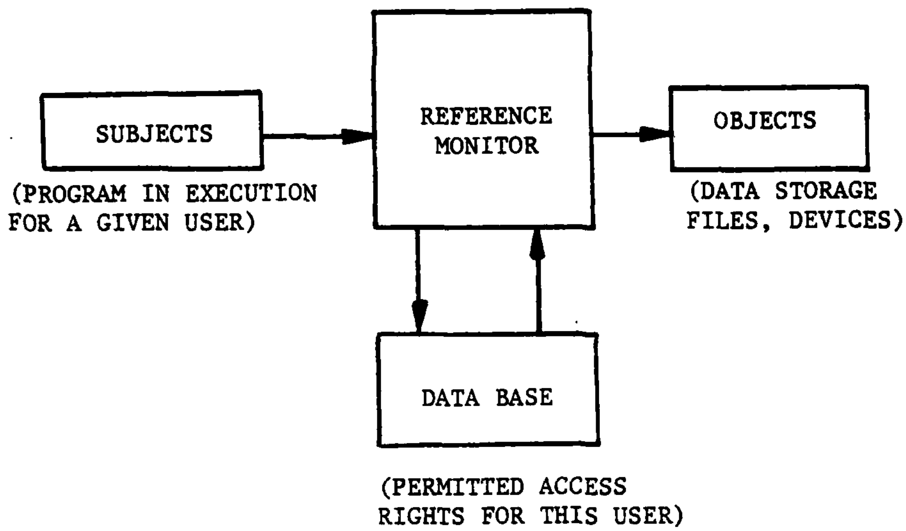

Figure 6-1 Reference Monitor Concept

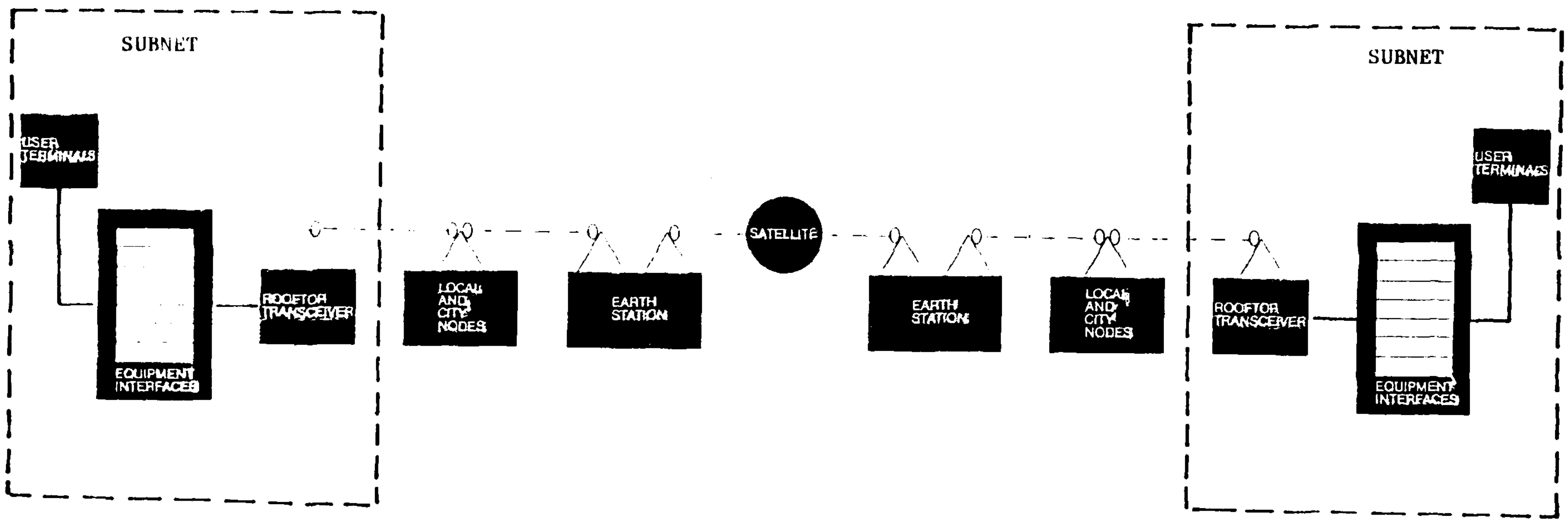

Figure 6-2 INFORMATION FLOW VIA XTEN

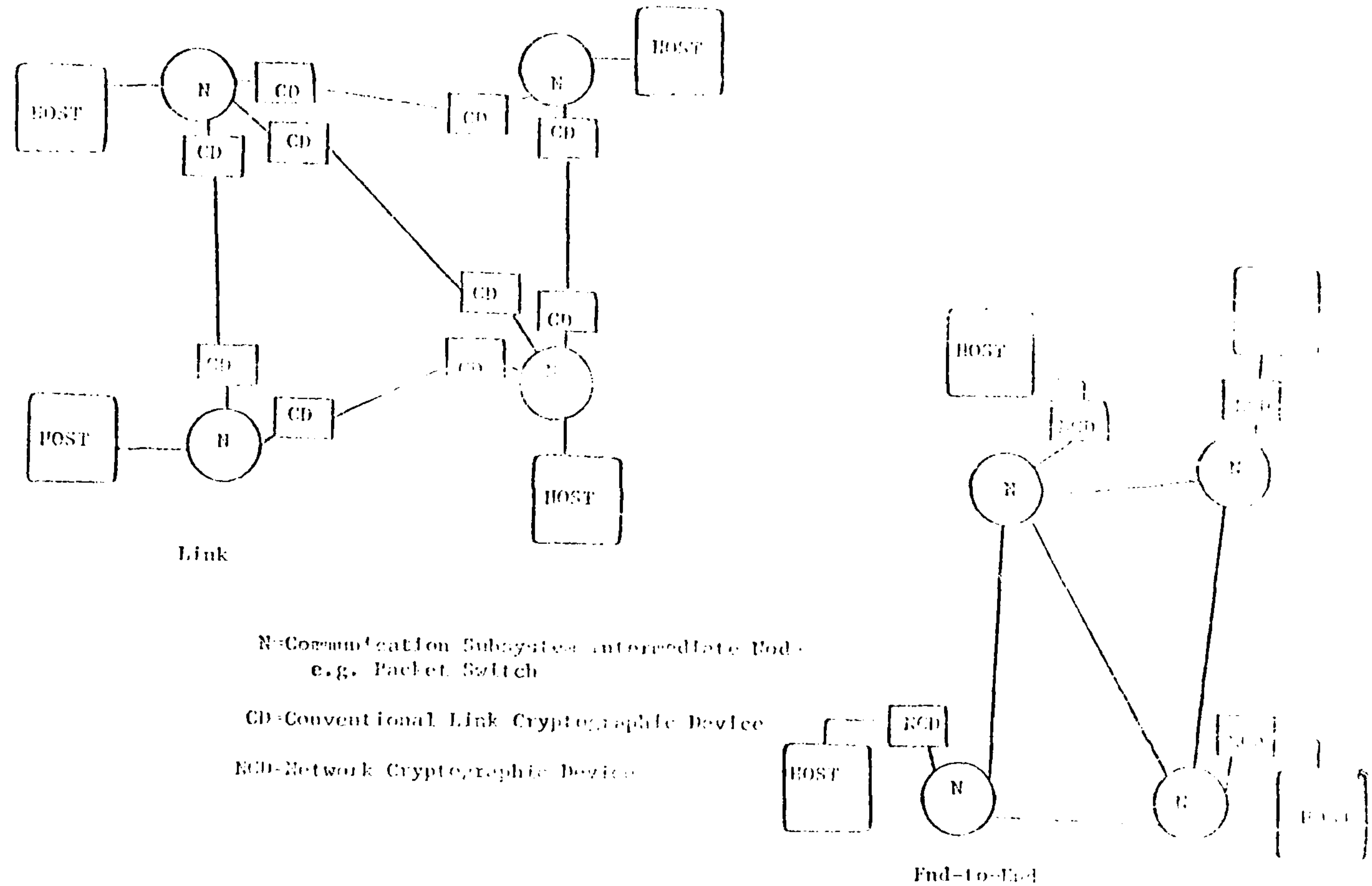

Figure 6-3 End-to-End and Link Protection

AD-A101 716 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH F/6 17/2
XTEN NATIONWIDE EMS PROPOSAL.(U)
1979 P B WARREN, C E WILSON
UNCLASSIFIED AFIT-CI-79-229T NL

2 of 3

Link-oriented

Link-oriented protects the computer information on the communications link between two nodes. Providing protection of this sort is based on the assumption that it is much easier to attack the link than the nodes. However, subversion of one of the packet switching nodes results in exposure of all data traffic through that node. In this case, for buffered traffic, security can be enhanced by storing message traffic in its encrypted form. Therefore in a link oriented environment, subversion of one node could result in exposure of substantial amounts of traffic if not further protected.[38]

Link oriented protection does provide the advantage that if the only unsecure area is in the subnetwork itself then transparent protection is provided other subscribers attached through the network.[39]

End-to-End Measures

Instead of considering the network as a collection of nodes connected by a transmission link, it can be pictured as a medium for transporting messages. Based on this criteria, end-to-end measures will protect information from sender to receiver. This prevents the exposure of message traffic if subversion takes place in any part of the communications link.

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[38]Dixon R. Doll, Data Communications (John Wiley & Sons New york, 1978) p. 417.

[39]Stephen T. Kent, "Network security: a top down view shows problem", Data Communications (June 1978) p. 61.

Attacks on Networks

Table 6-1 categorizes the various attacks on data security.[40] The intruder can position himself within the network such that all information of value to him must pass through his intercepted area. In this position it can be assumed that both passive and active wiretapping techniques can be employed by the intruder.

In passive wiretapping, the intruder observes the packets passing through without disturbing their flow. He can observe portions of the packet headers and although the data may be intelligible, he can learn the locations and identities of the communicating parties.[41] Length of packets and frequency of transmission offers some information to the intruder as well. All of these intrusions can be termed as traffic analysis.

In active wiretapping the intruder makes modifications to the traffic (i.e. delete, delay, duplicate etc.).

Of course it is the responsibility of the data security environment to defend against attacks such as these. Some techniques in use today are:

1. Encryption
2. Node Security
3. Dummy Concealment
4. Use of request-response protocols
5. Authentication

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[40] Stanley Sinkler, Lee Danner "Data Security in the Computer Communication Environment", Computer Communications, (IEEE Inc., New York, 1974) p. 70.

[41] Stephen T. Kent, "Network security: a top down view shows problem", Data Communications (June 1978) p. 62.

Table 6-1 Categories of attackes on Data Security

CATEGORY		DEFINITION
Unauthorized Disclosure	Exposure	The accidental disclosure of data to unauthorized persons.
	Interception	The deliberate seizure of data by unauthorized persons.
Unauthorized Modification	Alteration	The accidental change of data
	Deception	The deliberate change of data
Unauthorized Restriction	Interruption	The accidental denial of proper access
	Disruption	The deliberate denial of proper access
Unauthorized Destruction	Erasure	The accidental expunging of data
	Elimination	The deliberate expunging of data

Encryption

Encryption serves both as a countermeasure to passive wiretapping and as a basis for building countermeasures against active wiretaps.[42] It is possible that encryption could be the only effective method available today for preventing the unauthorized disclosure of computer data.[43]

The federal data encryption standard was developed by IBM in 1974 during a National Bureau of Standards solicitation for a government wide standard. It was to be used for the encryption of unclassified government data. DES was selected as the standard in 1977.

The DES is well suited for use in Networks because of the following characteristics.

1. The secrecy of the transformation is dependent only on the secrecy of the key, not on the secrecy of the algorithm.

2. It operates on 64-bit blocks, eight are reserved for parity, using a 56 bit key. The key is not so short that it would encourage exhaustive search techniques nor is it too long as to make distribution to remote devices difficult.

3. The algorithm is block-oriented. Data is grouped into 64 bit blocks which can be enciphered and deciphered independently. While the same key is in use, position or time synchronization of encryption with decryption is not required.

Due to differences in routing and transmission, message transmit time will be variable. Messages may arrive at a destination not in the same order as sent. Use of the NBS algorithm, makes it possible to build cryptographic devices which do not require position or time synchronization and are not dependent on the communication subsystem.

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[42] Ibid.

[43] "Data Encryption: Is it for You?", EDP Analyzer, (December 1978) V 16, No. 12 p. 1.

4. In the ECB mode, the cryptographic synchrony required for correct deciphering of messages is achieved when both sender and receiver employ the same key and blocks are correctly delimited. If there is a difference of even one bit between encryption and decryption keys, gibberish will be obtained from the system.

5. Analyzing the clear/enciphered text pairs will not aid in codebreaking to determine the key used. This means exhaustive search techniques would have to be used by potential penetrators.

6. The DES is expected to be available as an LSI package. This will provide a low cost, high speed implementation suitable for use in cryptographic devices.[44]

Figure 6-4 illustrates the ECB mode of using DES.[45] There are other modes of use of DES but they will not be discussed in this paper.

As previously mentioned nodes represent the potential where large quantities of information could be lost. Therefore, node security must be considered when establishing a secure network.

Node Security

Since, in link-oriented security, encryption involves the information transmitted over the links and not within the nodes connected by these links, these nodes must be secure (both hardware and software). Security of nodes can be provided by the network control centers. Each node should be designed such that it reports to the network control center on a continuous basis with pertinent information. In the event a certain periodical report

[44]U.S. Dept. of Commerce, The Network Security Center: A system level approach to Computer Network Security. NBS Special Publication 500-21, V2, p. 20.

[45]Stephen T. Kent, "Network security: a top down view shows problem", Data Communications (June 1978) p. 72.

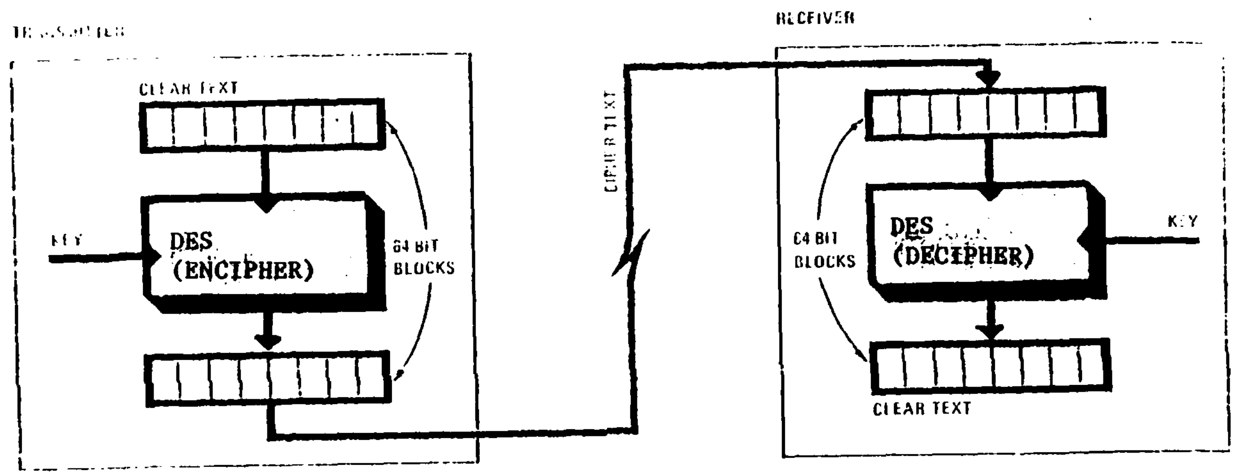

Figure 6-4

ELECTRONIC CODE BOOK MODE OF DES

Basic Scrambling. Using the National Bureau of Standards' DES as a model, 64-bit blocks of clear data are scrambled through the use of a secret encryption key. Enciphered data is exposed on the way to the receiving end where a duplicate key is used to unscramble the message. Success or failure depends on key secrecy.

is not received, the network control center operator should have the option to poll that particular node to determine the state of the node.

Dummy Concealment

Dummy concealment merely protects against an intruder determining the frequency and length of packets.[46] Dummy packets of various lengths can be generated whenever actual data is not being transmitted to meet artificially selected frequency and length patterns. An enciphered flagging mechanism can be used to indicate to the receiver that the contents of the dummy message are to be discarded.

Request-Response Protocols

Request-response protocols protect against message denial. A timer is used to periodically trigger the release of a request message that forces a response from connected terminals. These messages relay the status of the transmitter in terms that permit detection of missing messages from the connection.[47]

Authentication

This is the concept of identifying and validating the claimed identity of subscribers. Several techniques have been developed to carry out this procedure: specifically various password schemes, badges and keys, and physical characteristic measurements such as fingerprints, signature, and voiceprints.

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[46] Ibid. p. 69.

[47] Ibid.

Authentication in another sense may pose a problem for XTEN's message and document distribution services. Authentication now becomes the process of positively identifying a document's source, date and status as original or copy.[48] And still another is how the recipient of a message can be sure of its source. Some form of authentication from the sender to the receiver will have to be developed to ensure that he/she is not being misled or harmed by fraudulent messages. Perhaps the most promising authentication for document and message verification would be signatures. Our presently practiced methods of conducting business makes written signature absolutely essential. They are used as a form of certification on such things as contract agreements, however before electronic means can fully replace hard copy forms of information a digital equivalent to a written signature will be required.[49] While this appears to be a logical impossibility, digital signatures can be obtained from a public key system.[50]

It myst be pointed out that there is no single answer to the amount of security required in all applications. The cost of protection must be weighted against the value of the information being protected.

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[48]EMS: The technological,market and Regulatory Prospects, April 1978 p. 220.

[49]Martin E. Hellman, "Cryptographic Protection of Information in Communication Networks", <u>11th A silomar Conference on Circuits, Systems and Computers,</u> (IEEE, New York, 1978) p. 204.

[50]<u>Ibid.</u>

This chapter has explored the basic development of a secure network with a focus on the basic issues of privacy of information and data security. Integrated service networks like XTEN may either intensify security problems or may provide meaningful solutions to them depending on the network design. Therefore, since Xerox is providing the transmission media to carry, at times, sensitive data it should follow that they be responsible for insuring the confidentiality of that data, and consider the various design requirements as discussed in this chapter.

CHAPTER VII

COST-BENEFIT

Trends in technology and future requirements for telecommunications systems are expected to exert considerable pressure on organizations in developing better switching and network architecture.[1] These interrelated trends include the growing diversity in data terminals, types of information and services, advances in digital circuitry and application of satellite transmission techniques.

One way of achieving a more cost effective and efficient communications system is through a unified network arrangement.[2] They provide for maximum interconnectivity of diverse terminal types and more efficient use of transmission facilities, thus a more economical approach than that of separate networks.[3]

A well established principle in finance literature on acquiring new assets is that the user, who invests in an asset in order to obtain benefits from its services over a given period, should choose the type of asset and form of acquisition which will

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[1]Marion J. Ross, "System Engineering of Integrated Voice and Data Switches", 1978 International Conference on Communications (IEEE, NY 1978) p. 20 5.1.

[2]Ibid.

[3]Ibid.

provide him with maximum gains. This means either maximimzation of profit (where ascertainable) or minimization of costs. In either case, the choice from alternative means of acquiring assets should be determined on the basis of their respective net present values.[4]

It is at this stage, impossible or difficult at best to determine what savings XTEN will afford it subscribers. Since this is the case, the network will be analyzed in terms of how cost-effective the network is to the common carrier, and in turn, cost-effective to the subscriber. Additionally certain XTEN service offerings will be discussed to determine what benefits, if any, can be obtained in relation to reduced operating cost.

Common Carrier

Xerox in its development of the proposed XTEN system utilizes several cost-effective design features. Specifically the network will utilize:

1. Satellite transmission with TDMA
2. All Digital transmission
3. Radio packet switching
4. Network transparency

Satellite transmission is cost-effective in the sense that, transmission cost is independent of distance. A link from Washington to Baltimore costs the same as a link from Washington to

[4]Robert W. Johnson and Wilbur G. Lewellen, "Analysis of the Lease-or-buy Decision". Journal of Finance, September 1972.

Vancouver.[5] However, so as not to mislead the reader, Xerox will lease satellite transponders from a Domestic Satellite Carrier. Therefore the prices will vary from location to location. These prices, however, should be somewhat smaller as compared to a comparable telephone company long haul transmission link. By using satellite transmission links to its node locations, and bypassing AT&T facilities, Xerox stands to save money; just how much cannot be determined at this time.

Time Division Multiple Access (TDMA) gives more efficient utilization of transponder capacity. TDMA systems are easily adaptable to change and growth in traffic patterns since the capacity of any station is proportional to the allocated time it may accesss the satellite.[6]

The economic reasons for using digital transmission stems from several factors.

First, the mass production of digital circuitry is dropping in cost due to LSI (Large scale integration). This means that flexible switching control can be realized along with more efficient and versatile use of the transmission network.[7] Because

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[5]James Martin, Telecommunications and the Computer, (Prentice Hall, Inc., Englewood Cliffs, New Jersey, 1976) p. 299.

[6]Andrew Werth and Paradman Kaul, "TDMA Provides a Solution for Multi-User Satellite Network", Communications News (March 1979) p.62.

[7]Minoru Akiyama, A Consideration on design of flexible digital communication Network, 1978 International Conference on Communications (IEEE, NY, 1978) p. 11.6.1.

telecommunications networks use large amounts of circuitry, the benefit from mass production economics of LSI is enormous.

Secondly, digital transmission makes it possible to operate on links with high signal to noise ratios.

Thirdly, over digital links, data can be transmitted with a total equipment cost which can be as low as a tenth of that for transmission over analog links with modems.[8]

Another important advantage is that different kinds of traffic (message, facsimile, data) can easily be integrated in the digital network. Signals such as message, facsimile, and data all become a stream of similar-looking pulses. As a result of this, interference is non existant between signals and will not make differing demands on the engineering of the channels.[9]

Finally the high bit rates which will be available will allow users to interconnect with the system through the use of microwave radio links, thus avoiding the telephone local loops which suffer from reliability problems.

Increasing numbers of organizations are building intelligent networks based on packet switching transmission. (Appendix C describes the packet switching technology). It has been used by the Value Added Carriers such as TELENET and also by the Advanced Research Project Agency (ARPA) in its ARPANET.

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[8] James Martin, Telecommunications and the Computer, (Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1976) p. 267.

[9] Ibid.

Packet switching is volume sensitive, that is, if there are many users such that the average line utilization is high, then the cost per 1000 bits to the users becomes lower than the rates for the switched telephone or telegraph networks.[10]

ARPA is conducting experiments in the Palo Alto, CA. area on the feasibility of radio packet switching. The early measurements indicate that these systems are feasible and cost effective.[11]

Access for local terminals has been a problem for teleprocessing system designers. This is true in that the cost of the local access portion of the network has been far too expensive relative to the rest of the communications. Radio packet switching promises to reduce this cost significantly.[12] Packet switching is an appealing way to design a public network if it can attract a very high volume of users.

Network transparency is a concept which can effectively be used in data communications applications to save money and improve service.[13] Simply put, network transparency is a technique by which a function or process is given to a user without that user knowing how it was accomplished. It's advantages are,

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[10] Ibid.

[11] Leonard Kleinrock, "On resource sharing in a Distributed Communication Environment", IEEE Communications Magazine, (January 1979) p. 3..

[12] Ibid.

[13] Alan M. Warshaw, "Network Transparency", Data Communications (July 1979) p. 43.

1. Terminal selection is easier because such factors as code sets and interface characteristics are not constraints in a transparent environment.

2. Host utilization is more efficient when there are no network-processing distinctions to be considered.

3. Different data rates and device types no longer require duplication of transmission equipment.

4. Application flexibility is considerably enhanced.[14]

Not by any means is this an all encompassing discussion on the cost-effective measures Xerox employed in developing its XTEN network, however if the measures mentioned are truly cost effective, then it should follow that subscibers should reap some benefits.

SUBSCRIBER BENEFITS

Service supplied by network resource sharing systems must be evaluated in economic terms if alternative systems with different benefits are to be compared.[15]

Cost-Benefit analysis involves the comparison of the cost of the system against the benefits which are to be obtained and whether the benefits outweigh the cost of some other alternative. The steps involved in performing the comparison include:

1. Determining the cost of each system (or service).

2. Determining the benefits which can be obtained from the system in question.

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[14] Ibid. p. 49.

[15] Sandra A. Mamrak, "A Network Resource Sharing Module to Augment User Cost-Benefit Analysis", Computer Networks-Trends and Applications, IEEE, 1976 p. 79.

3. Determining the functional relationships between cost and benefits that define their interaction and

4. Establishing a set of guidelines for choosing the best system, based on the cost and benefit data.[16]

There are significant advantages in organizations opting for networks such as XTEN:

1. Separate groups of circuits for message, data, and image transmission can be combined, thus reducing the number of transmission facilities.

2. Users have tended to develop a multiplicity of single application networks, resulting in incompatible and under-utilized networks. Therefore it follows that a single application network may be unwarranted if that particular traffic volume is low, however the combined requirements (message, data, image) might.

3. Networks like XTEN will facilitate the use of new service offerings once available.[17]

The managing of multiple networks, including the monitoring of their performance, is an expensive and time-consuming job. Services like XTEN can eliminate user concern about topological optimization, network maintenance, and network operational costs. Administration benefits of this sort cannot be over looked in today's cost conscious climates.[18]

In view of the advantages of integrating communications requirements and with the reduction in some administrative procedures, it appears, that there are obvious areas of cost reduction

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[16] Ibid.

[17] Howard Frank, Network Analysis Corp. Data Communications (September 1978) p. 57.

[18] Dixon Doll, Data Communications - Facilities Networks and Systems Design, (John Wiley & Sons Inc., 1978) p. 136.

and areas where a more efficiently run operation could be obtained. However organizations should proceed with caution when attempting integration for there are some disadvantages which should be evaluated as well.

Xerox believes that improvements in such offerings as document distribution (specifically facsimile transmission) and teleconferencing can greatly increase organization efficiency and reduced operating expenses. In an earlier chapter it was mentioned that with current facsimile machines it could cost 72 cents to send a quarter page of typewritten material over a long distance circuit. A high speed digital machine operating at 2500 bps could reduce this to 18 cents, while a 4800 bps machine would cost around 10 cents per copy.[19] This is less than what it costs to send a letter through the mail.

Obviously there are many more factors which should be considered when costing digital facsimile transmission. But considering the reduced cost for faster transmission plus the other advantages of excellent copy quality and immediacy of communication, it seems likely, that this is a good area for better productivity and reduced operating costs [20] provided facsimile transmission is used by the organization.

Since the so-called energy crisis of 1973, and the one which

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[19] B.G. Smale, High Speed Digital Facsimile Systems, <u>International Conference on Communication Equipment and Systems,</u> IEEE p. 176.

[20] <u>Ibid.</u>

is taking place now, there has been growing interest in the development of ways to conserve some of the energy used in transportation. Examples of some measures taken include:

1. Establishment of fuel allocation regulations by the Federal Energy Administration.

2. Speed limits were lowered to 55 mph, and use of mass transit and car pools encouraged.

3. Odd and Even gas rationing has been initiated in some states.

4. Thermostats in government and commercial establishments have been ordered set at 78 degrees in summer months.

Teleconferencing has been another alternative organizations have been exploring for possible energy reduction.

Teleconferencing can only be attractive from the standpoint that it saves money and gives improved productivity. NASA has estimated that at one extreme its Apollo teleconferencing system saved, in terms of travel, $9.47 for every dollar spent on teleconferencing services.[21] Dow Chemical USA estimates that they have saved about two dollars in travel costs for every dollar spent on teleconferending.[22]

Teleconferencing can also reduce the time required for professionals and executives to complete a job. Dow Chemical USA

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[21] Charles E. Lathey, Telecommunications Substitutability for Travel: An Energy Conservation Potential, U.S. Department of Commerce, January 1975, p. 69-70.

[22] Ibid.

estimates that a one hour teleconference call is equivalent to two days of travel and conferencing time.[23]

If teleconferencing does reduce the need for travel for professionals and executives then it should follow that less energy consumption will occur as a result. However, in the Department of Commerce Report, Telecommunications Substitutability for Travel, it was concluded that teleconferencing cannot be used as a lever to bring about energy consumption reduction in travel. But in light of the disincentives to travel teleconferencing could be used as a substitute for some travel[24] and consequently reduced operating costs.

The point must be made that Xerox is not the only organization offering service features such as digital facsimile and teleconferencing capabilities. But because these offerings would be offered in an integrated network it is likely that they would be much cheaper than separate single application networks.

Since the primary cost of a network is in the transmission segment,[25] the integration of differing traffic types can lead to more efficient and cost-effective practical systems where switching equipment and transmission capacity could be shared, thereby

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[23]Ibid.

[24]Ibid.

[25]Marion J. Ross, "System Engineering of Integrated Voice and Data Switches", 1978 International Conference on Communications (IEEE, NY 1978) p. 20.5.1.

reducing expenses for the entire network.[26]

The true benefits provided subscribers by XTEN can only be fully evaluated once the system is approved and Xerox releases the various cost figures for service. However at this point it can be concluded that there is a need for most cost-effective and efficient networks. This need can be satisfied by an integrated approach which appears to offer considerable advantages over conventional ones.

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[26] Ibid.

CHAPTER VIII

THE MARKET FOR THE PROPOSED EMS SERVICE

What is EMS?

The term EMS appears to be one of the most popular new words in the telecommunications industry. EMS refers to Electronic Message Systems. At is face value EMS would seem to encompass almost every type of telecommunications service. Thus, in order to discuss the Xerox proposal, a clearer and narrower definition of EMS must be found. Then it will further aid this discussion to point out what specifically the Xerox EMS system is in relation to the basic EMS definition.

EMS is often used to refer to Electronic Mail Systems as well as Electronic Message Systems. However the distinction between these two services is so vague that the terms can be used almost interchangeably. A good example of this can be seen in EMMS (Electronic Mail and Message Systems Newsletter). When defining EMS and describing their title they stated "Because of the blurred definition, this newsletter has adopted the term 'Electronic Mail and Message Systems' to refer to a wide range of electronic delivery systems for messages on both inter-company and intra-company basis."[1]

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[1]Stephen A. Caswell. "An Electronic Mail and Message Systems Primer", EMMS. Vol.2, No. 7, April 3, 1978,p.2. (Copywrite permission received via phone.Written permission has been applied for.)

Thus probably one of the easier ways of defining EMS is to list the types of systems encompassed. These are Data Communications, Telex, TWX, Facsimile, Mailgram Telegram, Message Switching and Communicating Word Processors.[2] Below is a more specific definition of EMS.

> ...it is a phrase which denotes the transmission of character encoded information by electronic means from terminal to terminal in units recognized as messages, which would otherwise be transmitted physically through the postal system or verbally via telephone.[3]

It should be noted that this definition omits the previously mentioned Mailgram and some Facsimile devices, because they are not character encoded. However, in a footnote to this definition it was pointed out that "Digitized facsimile between end uses is, however, encompassed by that definition."[4]

Thus, even in the industry and the FCC there seems to be some disagreement as to what EMS actually is. However, for the purposes of this paper let us suffice it to say that the second more specific definition is applicable.

Xerox proposes a system which will not be in conflict with our definition of EMS.[5]

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[2] Ibid. p. 2.

[3] Kalba Bowen Associates and The Massachusetts Institute of Technology, Electronic Message Systems: The Technological Market and Regulatory Prospects, FCC Number 0236, April 1978, p. i & ii.

[4] Ibid. p. ii.

[5] EMS in Xerox's terms stands for Electronic Message Service. EMS normally refers to Electronic Message Systems. They both mean essentially the same thing.

> On November 16, 1978, Xerox Corporation filed a petition with the Federal Communications Commission requesting reallocation of radio frequencies from 10.55 to 10.68 GHz for the establishment of a new Electronic Message Service (EMS). This service will facilitate the development of competing high speed digital networks for the nationwide communication of business information such as facsimile, computer data and teleconferencing.[6]

Thus the Xerox system will transmit "character encoded information by electronic means from terminal to terminal in units recognized as messages". Since the encoded information "will not be transmitted physically through the postal system or verbally via telephone" (unless they interconnect with another EMS network) XTEN is definitely an EMS as defined by the Kalba Bowen Associates Inc. and the Center for Policy Alternatives (MIT) joint report to the FCC on EMS.

Although the Xerox EMS proposal specifically mentions facsimile, computer data and teleconferencing, other services will be offered. Among those not mentioned are two way digitized voice[7] for teleconferencing and communications between word processors. These services, combined with data communications, teleconferencing and facsimile are designed to serve what Xerox calls "The Office of the Future"[8]. What are the demands and what will be the demands

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[6]Richard Wiley, John Bartlet, Lawrence Secrest III, Danny Adams, Executive Summary of Xerox Corporation Petition for Rulemaking. November 16, 1978, p. 1.

[7]Although Xerox proposes two way digitized voice for their XTEN system, it is doubtful that this will be offered. Unlike SBS XTEN is packet switched and thus instantaneous voice may not be effective.

[8]Ibid. p. 1.

for a Xerox type of EMS in the Office of the Future?

The EMS Market

The United States has indeed become an information based economy.

> In 1967, 25.1 percent of the U.S. Gross National Product (GNP) originated with the production, processing and distribution of information goods and services sold on markets. In addition, the purely informational requirements of planning, coordinating and managing the rest of the economy generated 21.1 percent of GNP. These informational activities engaged more than 46 percent of the work force, which earned over 53 percent of all labor income. On the strength of these findings, we call ours an 'information economy'.[9]

Thus the necessity for better ways to communicate this information has also become increasingly important. In fact one of the changes that the information society is causing in our economic organization is the growing importance of computers and communications. As Marc Porat of the Aspen Institute states "But the importance of communication, relative to other aspects of life, has taken on a new meaning: communication is central for an information based society.[10] Thus an EMS would seem to have a place in the present U.S. economy. However, how much of a place EMS will have is difficult to judge.

> During the course of performing our literature survey (see Appendix B), we uncovered very few quantitative assessments of future EMS growth. Those that were available to us focused

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[9] Marc U. Porat, "Communication Policy in an Information Society," Communications for Tomorrow. (New York: Praeger Publishers, 1978) p. 4.

[10] Ibid. p. 4.

> for the most part on shipments of certain types of terminals, which could be used in EMS, rather than on the future volume of EMS messages or number of EMS users.[11]

Thus, at present the only quantified market prediction concerning EMS is the one prepared by Xerox in their petition to the F.C.C.. In fact many feel that such predictions are impossible in such a new service. "Any honest marketing researcher would confess that it is impossible to forecast accurately the market demand for such a radically new service as computer mail."[12]

Consequently it is important to examine the five growth factors identified by the FCC contract paper Electronic Message Systems: The Technological, Market and Regulatory Prospects (0236).[13] These factors are Supply, Acceptance, Marketing, Threshold and Substitution.

The Supply Factor. The equipment in the EMS marketplace will have to provide users with accessibility, reliability, flexibility, ease of use, etc. However, each of these features will obviously add costs to that equipment or service. As the technologies advance in these areas, costs will go down and demand will rise. Thus the market for such products (and ultimately EMS) will be dependent on equipment supply costs. In short, the manufacturers

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[11] Kalba Bowen Associates and MIT Report, p. 149.

[12] Raymond Panko and Rosemarie Panko, "An Introduction to Computers for Human Communication", Communications News, December 1977, p. 34, as quoted in the Kalba Bowen Associates Report and MIT Report, p. 149.

[13] Ibid. p. 162-169.

of terminals, facsimile machines and other equipment which will be used in an EMS network, such as Xerox's will largely determine the market for the entire EMS industry.

The Acceptance Factor. Here the basic question is, will users accept the EMS services? Among the variables contributing to this factor are cost effectiveness (as compared to other services), rising needs for more rapid delivery, how much the user will have to pay to connect, greater convenience, the organizational impact of the services (span of control etc.), obsolescense of current equipment and "power" struggles within user organizations (e.g. among telecommunications, data processing, and office managers).[14] In short, to what degree will each of the above variables affect customer acceptance of EMS over some other communications medium? The importance of each of these variables will need to be gauged before any valid market projections can be made.

The Marketing Factor. The success of EMS will largely depend on how well the requirements of users are met and how well the identification and education of potential users is conducted. In other words, how well EMS is marketed will directly affect the nature and scale of EMS demand.

The Threshold Factor. Certain businesses and government entities will adapt more readily to EMS use than others. Once EMS is accepted as a standard communications mode, penetration will increase more rapidly. As compatability problems are overcome the

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[14] Ibid. p. 163.

rate of penetration will increase. Therefore, the market growth to a large extent depends on when various user groups accept EMS as a useful, cost effective communications medium. The market growth will be much more rapid after this point than before it.

The Substitution Factor. This is a question of the cross elasticity between EMS and other industries. EMS growth may take business from some industries and create more business for others. Conversely, new (as yet to be developed) technologies may compete with EMS and reduce its growth.

As can be seen, the five growth factors make accurate market predictions for EMS almost an impossibility. Although the use of EMS is currently expanding, there are as of yet so many unknown variables that the degree to which growth will take place is almost impossible to determine.

The Xerox Market Projections

Included in the Xerox Petition for Rulemaking were rather elaborate projections for their proposed service. The stated purpose of the projections is listed below.

> This section will discuss the expanding communications needs of business and governmental organizations, and the inability of existing data communications systems to meet those needs. It also will explain the role which nationwide EMS networks can play in satisfying such service requirements, thereby contributing to significant improvements in office procedures.[15]

[15] Richard Wiley, John Bartlett, Lawrence Secrest, Danny Adams, Xerox Corporation Petition for Rulemaking, November 16, 1978, p. 9.

To support this statement, Xerox attempted to quantify the demand for each service (and for all three combined) in terms of the Annual Traffic in bits. This traffic was projected for the years 1980, 1985 and 1990. In several situations, however, Xerox admitted that no firm statistics were available. For example, in their discussion of data, they stated,

> a. It is impossible to estimate accurately the total amount of data which conceivably could be communicated by U.S. businesses and government organizations.[16]

Then we were provided with an estimate of data revenue in billions of dollars for the years 1965, 1975, 1980 and 1985.[17] Furthermore Xerox stated,

> The number of data bits transmitted in the United States is not known with great accuracy. An estimate presented to the Senate Subcommittee on Communications by Professor Manley Irwin was on an order of magnitude 10^{15} bits per year.[18]

These two estimates were combined to provide "Data bits transmitted per year".[19] Unfortunately, the fact that Xerox based its estimates on other people's estimates and admitted that accurate estimates are impossible, tends to make their projections for data very questionable indeed. In short, accurate quantified predictions cannot be based on inaccurate estimates.

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[16] Ibid. p. 8c.

[17] Ibid. p. 8c (Presentation by Edward Collier to the American Institute of Industrial Engineers, April 1976).

[18] Ibid. p. 8c (Senate Subcommittee Hearings, U.S. Government Printing Office, serial 95-42, p. 1145).

[19] Ibid. p. 8c.

A second problem with the Xerox attempt to quantify market demand lies in the fact that many of their sources were not documented. For example, in their discussions of document distribution Xerox mentions external studies.

> The projection of market potential for document distribution is based on estimates of current document flows on a nationwide level which have been collected from Xerox proprietary data and external sources.[20]

It is difficult to judge the accuracy of proprietary data. Although Xerox probably had good reason to not reveal the sources of this data, it is nonetheless difficult to be certain that this is accurate information. For the reasons stated above, the Xerox attempt to quantify future market demand is in all probability not very accurate.

In the course of constructing their market projections Xerox discussed the market it is aiming at. If they know what companies will most likely use their services, they could have conducted a market survey[21] to see what the demand for such an EMS service is now. Of course, user ignorance of the Xerox plan and other lacks of awareness would surely complicate such an effort. However, this user input, in combination with the quantified studies, might present a more accurate picture of the market potential.

On the other hand, in its discussion of current problems and proposed solutions, Xerox did a much better job. For example, in their discussion of Teleconferencing they cited the NASA use of

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[20]Ibid. p. 5c.

[21]The Proprietary data mentioned earlier may have included this type of market survey.

that service and the resultant savings in excess of 20%.[22] In addition they cited a Stanford Research Institute study that showed similar savings.[23] With the current (and likely to continue) energy crisis, Xerox made a fairly good case for their teleconferencing service.

Thus, because of the newness of the EMS concept, quantified market predictions are a somewhat futile effort. Accurate data to make accurate predictions is simply not available. Secondly, the five factors or variables previously mentioned will, to a large degree, determine the market for EMS.

For example, even if Xerox had accurately determined the number of prospective users, they have no way of knowing how quickly or in what numbers the users will accept the services. Similarly, with the threshold factor, it is impossible at this time to determine in what industries EMS will grow most readily and how fast that growth will take place. On the other hand, Xerox could substantially influence the Supply Factor. As a leader in the production of Word Processors, Facsimile devices and other EMS equipment, Xerox may be motivated to advance technologies in these areas to minimize the cost vs. features tradeoff. This would significantly increase the market for the proposed EMS. Also, Xerox to a great extent could substantially influence the Marketing Factor by identifying and educating potential users.

However, as technological advances are made in the area of EMS,

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[22] Ibid. p. 15.

[23] Ibid. pp. 15 and 10c.

advances in other areas may create new services that may detract from the EMS marketplace (The Substitution Factor). Therefore, any attempt to quantify the EMS market is an exercise in futility. Rather, to determine whether or not a market exists for XTEN and other EMS services, some general indicators should be examined.

Indicators of the EMS Market

Obviously, XTEN will not be the only purveyor of Electronic Message Systems. As one recent article on Networks stated:

> One mistake often made in assessing the likely impact of ACS, SBS or XTEN is to view them in isolation, neglecting their relationships to each other and to a variety of other network services which exist today and are growing in numbers and sophistication.[24]

Thus as can be seen Xerox will not be the only EMS service competing in the industry. Other services using their own methods of transmission and information processing already exist or soon will. However, the EMS market is and will be a large one. Xerox as well as ACS, SBS and the others are only going after specific portions of that broad market. Specifically Xerox is aiming at,

a. 62 companies with less than $100 million in annual revenue.

b. 207 companies with less than $250 million in annual revenue.

c. Several federal and state government agencies.[25]

SBS is aiming at the larger corporations.

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[24] Winston E. Himsworth, "Networks: No Missing Links," Datamation, May 25, 1979, p. 107.

[25] Xerox Petition, p. 4c.

> The high capacity and flexibility will be of interest to SBS' expected market - those users with the largest communications requirements. Not surprisingly, those coveted top 200 companies and governmental organizations are the cream of IBM's (and AT&T's) existing business.[26]

On the other hand, "As such, ACS is aimed at a broad base of potential customers, large and small data users alike."[27]

Consequently, although all three services will use different transmission methods, competition in the areas of speed and service will exist. Furthermore, existing EMS services will also provide competition.

> More new offerings can be expected, but users should not discount the many existing network services which can handle their voice, video and data needs and which are growing in both size and sophistication.[28]

Circuit switched networks like Tymnet and SBS can offer voice as well as data capabilities. For example,

> As such it's not just a data communications service. In fact, in the early years, it is projected that at least 75% of the communications traffic on the SBS system will be voice. The other 25% would be made up of high speed data for facsimile, computer and data terminal traffic, and teleconferencing applications.[29]

However, unlike these services, the packet switched XTEN system will be primarily non-voice. Although Xerox mentioned digitized voice, in relation to the teleconferencing proposal, it is doubtful that Xerox will do much in this area due to its packet

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[26]Himsworth, Datamation, p. 110.

[27]Ibid. p. 110.

[28]Ibid. p. 110.

[29]Ibid. p. 107.

switched nature. Packetizing may not be well suited to voice traffic due to its store and forward nature. Thus the packetized Xerox system will be almost entirely a non-voice offering.

ACS and Telenet, like Xerox are packet switched systems. However, unlike Xerox, these are value added services which have been combined with voice networks already in existance. Value added services consist of the software and hardware necessary to perform control functions (packetizing, store and forward, message retrieval, etc.). These are then added to an existing network and the addition of these services add value to the network. Subsequently, they are called value added carriers. In most value added systems the subscriber can use both the value added services of the network and the traditional transmission circuits as well. For example, Bell's ACS system (using data under voice) will be a value added carrier. The user will be using the same network for his voice and data services. Although XTEN will offer both common carrier and value added services, little if any voice will be transmitted over the system. XTEN unlike other services was not designed for voice transmission and its packet switched characteristics may preclude voice offerings.

> Clearly one of the key decisions made by Xerox planners centered around the provision of voice communications services along with the packet switched record and data offerings. Because almost 90% of the typical business user's telecommunications service budget goes to pay for voice services, and only a little more than 10 percent on data, etc., it is evident that a service (such as XTEN) which focuses on the non-voice transmission needs of its users is operating in a thinner market than, for example SBS (which will offer integrated voice, data, and video services). The past history of the 'specialized common carriers, whose original authorizations were based upon the concept of offering specialized non-voice services

> (but most of whom immediately took aim at MTS and private line voice traffic) suggests that challenging Ma Bell for a piece of the big-voice transmission market is less risky than trying to compete in -- or create -- non-voice transmission. (Remember Datran?) [30]

Although the non-voice market may be smaller, another factor indicates that the Xerox system will be viable. With escalating costs in the United States Postal Service (USPS) (due to its labor intensive nature) and declining costs in the EMS industries (due to advancements in technology), a large portion of the mail business will probably go to EMS systems like Xerox.

> It is even more difficult to estimate the impact of the other EMS devices. But as noted, 80 percent of first class mail is clearly identifiable as business mail (44 percent business-to-business), and probably about 30 percent of all government and business transactions are amendable to transmission as electronic messages. It has been estimated that within the total 'message market' the USPS share will decline from 22.7 percent in 1970 to about 13 percent in 1980.[31]

Although the Federal government and others have considered the possibility of USPS competing in the EMS market this is unlikely for two reasons. First there is some doubt as to whether the structure of the USPS would adapt to EMS and secondly, whether it is fair for a government agency to compete with private enterprises.

It is therefore relatively clear that the EMS market is growing. Several companies are already in the industry and several more have proposals or are showing an interest. Electronic Mail

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[30]Stephen A. Caswell, "Xerox Enters the Communications Field with a Packet Switched Network," EMMS, December 1, 1978, Vol. 2, No. 23, p. 6.

[31]Henry Geller and Stuart Brotman, "Electronic Alternatives to Postal Service", Communications for Tomorrow. (New York: Praeger Publishers, 1978) p. 328.

Revenues will earn a projected one billion dollars in 1979.[32] Coded text services are yearly taking more and more revenues from the USPS. The energy crisis is creating a greater interest in teleconferencing and computer data traffic is at an all time high. Therefore, although the EMS market cannot be accurately quantified at this point in time, there is definitely a growing market for the Xerox type of Electronic Message Service.

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[32] Stephen A. Caswell "The Outlook for 1979", EMMS. Vol. 3, No. 2, Jan. 15, 1979. p. 1. (Carrier Revenues $712 million, Equipment Value $347 million, Total 1.059 billion.)

CHAPTER IX

THE XEROX PETITION FOR RULEMAKING

In November of 1978 the Xerox Corporation petitioned the FCC for rulemaking. The petition requested the reallocation of the 10.55 to 10.68 GHz for the purpose of establishing nationwide Electronic Message Services. In addition to the request for reallocation, Xerox also proposed several amendments to the existing rules. In December and January (1978 - 1979) several interested parties filed comments on the Xerox petition and later in January Xerox replied to those comments. On August 1, 1979[1] the FCC released a Notice of Rulemaking and Inquiry. Xerox hopes to implement service by late 1981 and whether they will or not largely depends on the rulemaking process mentioned above.

Undoubtedly further comments from interested parties and a reply from Xerox will be submitted to the Commission. Once these have been examined and deliberated on, the Commission will then promulgate the final rule (if the Xerox proposal is accepted). This could take several years and by then Xerox after having spent vast amounts of money on legal fees, possible studies, etc. may have lost interest. Although careful consideration is needed, the

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[1]Telecommunications Reports "Door Opened Wide for Xerox XTEN Plan" Vol. 45 No. 31, Aug. 6, 1979. pp 6-8.

regulatory lag could, potentially, destroy Xerox's incentive in providing their EMS service.

This is not to say, however, that the rulemaking procedure is a waste of time. The comments, regardless of their actual intent,have raised some very important questions concerning the Xerox proposal. These comments will be discussed in terms of the issues raised by the Xerox petition. Once these issues have been examined a recommendation will be made concerning the reallocation of the requested frequency band.

The comments made fall into three general categories. First, users of or potential users of the frequency band in question have opposed the reallocation, because in most cases it would effectively prohibit them from using it. In the second category, comments from EMS competitors criticize specific rules as unnecessary and/or anticompetitive. Finally, firms who perceive Xerox as a competitive threat have protested the petition and made suggestions that would effectively remove Xerox from the EMS market. Although some comments were initially favorable towards the petition, the reservations expressed fit into one of the three categories mentioned above.[2]

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[2]Reply of Xerox Corporation, January 30, 1979, p. 1.
Comments and letters were submitted by twelve parties: the Central Committee on Telecommunications of the American Petroleum Institute(API), American Satellite Corporation(ASC), American Telephone and Telegraph Company (AT&T), Computer and Business Equipment Manufacturers Assoc.(CBEMA), Common Carrier Assoc. for Telecommunications (CCAT), GTE Service Corporation (GTE), Litton Microwave Cooking Products, Inc., Microband Corporation of American, Rochester Telephone Corporation, Satellite Businesses Systems (SBS), Southern Pacific Communications Company (SPCC) and Visions Ltd.

Thus, this chapter will examine specific proposed rule changes in terms of the above categories of comments. The issues raised by the comments will then be examined in detail and recommendations will be made. Finally, overall recommendations will be made concerning the reallocation of the frequencies in question. Specifically, the final recommendations will propose some changes in the rules proposed by Xerox.

Competition for the 10.55 - 10.68 GHz Band

In its proposal to the FCC Xerox justifies its selection of the 10.55 - 10.68 GHz band in the following manner,

> 4.2 Optimum Spectrum Selection
>
> The choice of the optimum spectrum for the establishment of a new EMS depends upon the technical and system requirements for a reliable, high-speed digital communications service and the current availability of sufficient bandwidth to meet the total market. A careful review of these factors indicates that the band 10.55-10.68 GHz is suitable in terms of propagation and equipment design and, at present, is virtually unused.
>
> A technical overview of the frequencies between 2 and 20 GHz reveals trade-offs between the ability to acoomodate multi-path and fading at the low end and to overcome problems with weather phenomena and equipment availability at the high end. At the lower frequencies, for example at 2 GHz, it would be difficult to correct multipath, fading, and interference with antennas and transceivers which could be installed economically at subscriber locations.
>
> At higher frequencies, above 14 GHz, severe attenuation due to heavy rain becomes an important consideration. At the same transmitter power, receiver, and antenna size, the reliable service range decreases, requiring more local nodes and inter-nodal links. Implementation at these higher frequencies would create additional problems. Costs of components and equipment would increase while their reliability would represent greater risks. Currently, there is no known large-scale production of solid state 14-18 GHz equipment suitable to meet the require-ments for the new EMS subscriber and local node installations.
>
> Given the need to implement a reliable cost-effective service in the early 1980's, the optimum frequencies from an

engineering standpoint appear to fall roughly in the band 8 to 14 GHz. Consequently, Xerox retained Compucon, Inc., to research the current and proposed uses of the spectrum in this general area. The search revealed that the band 10.55-10.68 GHz contains adequate spectrum and is very lightly used.[3]

Litton Microwave Cooking products (Litton) and the American Petroleum Institute both protested the reassignment of the frequency band in question on the grouns that they would be potential users of the band themselves. Thus in order to determine who among those competing potential users of the 10.55-10.68 GHz band would best serve the public interest, each must be individually examined and then compared with the others.

On November 2, 1976, Litton petitioned the FCC for a rulemaking. Their petition urged that the 10.5 to 10.7 GHz band be allocated for use by microwave ovens. The grounds for their petition were,

> ...there is a substantial public need and desire for improvement in home cooking technology; that microwave oven design could be altered to meet that increasing public need; and finally, that use of this frequency band was uniquely suited to satisfy these requirements.[4]

They then further pointed out that,

> Our choice of 10 GHz is not an arbitrary choice. The physical interaction of 10 GHz with electromagnetic matter is the basis for our choice of 10 GHz rather than some other frequency...[5]

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[3]Xerox Petition for Rulemaking, November 16, 1978, p. 26.

[4]Litton Microwave Cooking Products, Comments on Petition for Rulemaking, December 29, 1978, p. 2.

[5]Ibid. p. 3.

Essentially what the 10 GHz frequency would provide for microwave ovens (that the other two currently allocated frequency bands won't) will be an improvement in the heating uniformity of those ovens. According to Litton the public interest will be served by this allocation because microwave ovens save energy. However, it should be pointed out that the teleconferencing and electronic mail (vs. physical delivery) also stand to save a tremendous amount of energy.[6] Furthermore, Litton is requesting 200 MHz of spectrum as opposed to XTEN's 130 MHz. This would use spectrum now allocated to the Radiolocation and Radio astronomy services as well as the Mobile service.[7]

Thus the public interest will best be served by the Xerox proposal to the exclusion of the Litton proposal. There are several reasons for this. First as stated earlier, less spectrum is used. Secondly, EMS could potentially save as much if not more than microwave ovens. Thirdly, nationwide EMS networks that save money and improve efficiency can cut consumer costs and favorably affect the economy. Finally, there is some evidence that microwave ovens would indeed interfere with a nationwide EMS. XTEN

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[6]Teleconferencing can eliminate up to 20% of business travel, according to a Stanford Research Institute Study and NASA experiences. Electronic Mail would save energy costs by eliminating the need for motorized vehicles for physical delivery.

[7]Pike & Fisher 52.106, p. 52,605, 47 CFR Section 2.106. (Microwave ovens do not actually need this much bandwidth. But at present there is a considerable amount of frequency variation within the oven and much of the band is used. A more efficient (but more expensive) transmitter could solve this problem).

proposes transmitting output powers of 0.5 and 0.4 of a watt for nodes and subscriber transceivers respectively.[8] Microwave ovens operate at powers of between 975 and 1500 watts.[9] This is roughly 2500 to 3000 times as much power as XTEN type EMS systems will use. Although microwave ovens are shielded and generally do not operate unless the doors are closed, they can leak electromagnetic radiation. This is particularly true when they are misused or damaged. In the <u>1978 Consumer Reports Buying Guide</u> microwave ovens were tested under such conditions. The leakage ranged from 0.7 mW/cm^2 to "over 20" mW/cm^2.[10] Thus the potential for interference does exist. Because of this potential Xerox and Litton can not share the same band. In addition, the microwave industry also has two other frequencies, one of which is largely unused. Therefore, in light of the arguments presented, Xerox's use of this band would undoubtedly be more in the public's interest than Litton's.

In its petition to the Commission Xerox recognized that the frequency band for the proposed EMS service is already being used by land mobile. However, as they pointed out,

> At present, the 10.55-10.68 GHz frequencies are virtually unused. Less than thirty licensees in the entire nation currently occupy this band and, in most cases, their usage is either experimental or very minimal. Xerox believes that these few active licensees can be accomodated within the 30

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[8] Xerox Petition, p. 15.

[9] <u>Consumer Reports Buying Guide Issue 1978</u> (Consumers Union: New York, December 1977) Vol. 42 No. 12, p. 13.

[10] <u>Ibid.</u> p. 13.

> MHz not allocated exclusively for nationwide EMS use or, alternatively, outside of the 10 GHz band altogether.[11]

Surprisingly enough, not one of the users in land mobile protested the Xerox petition. An article in Data Communications, published shortly after the Xerox announcement predicted otherwise.

> ...Mobile-radio manufacturers are unlikely to cotton to that, because the frequency band, though sparsley used at present, offers an expansion safety valve as radio channels in other bands get more crowded in metropolitan regions. And that is exactly where Xerox wants to use radio links for its XTEN.[12]

Yet the only other protestor was the Central Committee on Telecommunications of the American Petroleum Institute (API). Although they are not Land Mobile users, they were interested in the 10.55 to 10.68 GHz band as a possible place for further expansion. This in their eyes was especially critical in terms of the FCC's WARC proposal to allocate some portions of the 12 GHz band for satellite communications systems. Specifically, the 12.2 to 12.7 GHz band is now assigned to Operational Fixed Microwave services. This is the band that they would eventually expand into as their presently employed bands become congested. If the 12.2 to 12.7 GHz band is reallocated to satellite usage "...then the 10.55 to 10.68 GHz band would clearly be the most logical frequency spectrum available to provide the needed relief..."[13]

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[11] Xerox Petition, p. 3.

[12] "Xerox frequency plans threaten mobile-radio users," Data Communications, December 1978, p. 13.

[13] Statement of the Central Committee on Telecommunications of the American Petroleum Institute, November 29, 1978, p. 4.

However, when the FCC report was completed they stated "... We, therefore, are proposing that the broadcasting-satellite and terrestrial fixed services share the 12.2 - 12.7 GHz band and that the fixed - satellite service be allocated in the 11.7 to 12.2 GHz band."[14] Thus the API will still have the 12.2 - 12.7 GHz allocation to expand into.

Furthermore, even if they didn't they would have to petition the Commission for a reallocation of that frequency, as Xerox has done. The public interest, therefore, would probably be best served by granting the frequency to Xerox, to the exclusion of API for several reasons. First, API already has the 12.2 - 12.7 GHz frequency for expansion. Second, 10.55 - 10.68 GHz is not presently allocated to them anyway. Third, reserving spectrum for future expansive use, is not nearly as desirable as the Xerox proposal for spectrum to establish a new EMS service by late 1981 (depending of course on the regulatory process). Finally, although the Petroleum industry is indeed a large part of our economy, the Xerox EMS proposal will probably serve a larger variety of businesses, than the granting of the 10.55 to 10.68 GHz band for Private-Operational Fixed Microwave.

Thus the granting of 10.55 - 10.68 GHz for EMS will be more in the public interest than the Litton or API proposals. Also since no comments were received from Land Mobile radio users and the fact that 30 MHz for internodal distribution could be available

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[14]Federal Communications Reports <u>World Administrative Radio Conference</u>, (70FCC2d), p. 1252.

on a shared use to the Land Mobile users, again the 10.55 - 10.68 GHz band should be allocated to the Nationwide EMS.

Anti-Competitive Allegations

Several of the comments submitted accused Xerox of placing anti-competitive requirements in the proposed rules. Among the more important of these are, 1) the requirement to serve the top 100 SMSA's, 2) the specification of two way radio in the definition, 3) interconnection requirements, 4) a limit of less than 50% of service to the affiliates, 5) the exclusion of other common carrier services, 6) a demonstration of technical competence, financial qualifications, and the system configuration and the 7 year completion deadline. Each of the above issues will be examined to determine whether indeed it is or is not anticompetitive and, where needed, recommendations will be made.

The top 100 SMSA's. Throughout the comments probably the most frequently recurring objection was to the top 100 SMSA's service requirement. In sections 21.17g, 21.43c, 21.1101, and 21.1105 of Xerox's proposed rules this requirement is evident.[15] Specifically, under subpart M in the eligibility requirements the Xerox petition states,

> (a) Authorizations for node and subscriber stations in this service will be granted to existing and proposed communications common carriers. Applications will be granted only in cases where it can be shown that (a) the applicant is legally, financially, technically, and otherwise qualified to render its proposed service in, at a minimum, the 100 most populous

[15] Xerox Petition, pages 2a, 3a, 4a, 7a.

> Standard Metropolitan Statistical Areas (SMSAs), as determined by the most recent census conducted by the United States Census Bureau...[16]

AT&T and the Rochester Telephone Corporation were possibly the most vocal of the protestors (although other comments mentioned the concept). AT&T noted several reasons why the top 100 SMSA rule should be removed.

> ...First, while Xerox perceives a need for a nationwide service as defined by it, other carriers may perceive market needs of a lesser geographical scope. Second, with the wide dispersion of American industry to suburban and rural areas, the most significant market needs may be in areas other than the most populous 100 SMSA's. Third, the 100 SMSA requirement suggested Xerox could create insuperable financial and technical barriers.[17]

In its reply to the Comments, Xerox in essence stated that the top 100 SMSA requirement would guarantee a national network (which is the purpose of the petition - i.e. a Nationwide EMS network). They also argued

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[16] Ibid. p. 4a.

[17] Comments of the American Telephone and Telegraph Co., December 28, 1978, p. 6. Notes in a 1974 advertisement for their Digital Data Phone Service (DDS) AT&T stated ' "Ultimately to serve top 100 markets, although regulatory controversy impedes expansion." From: Dixon R. Doll, Data Communications, (New York: John Wiley & Sons, 1978), p. 110. (Copywrite Permission Applied for).

> Contrary to the suggestion of Rochester Telephone (at 3) and CCAT (at 5) nationwide EMS service cannot be assured through a number of independent regional networks. Additionally, most of the advanced value-added communications features which distinguish EMS from simple transmission service would be lost through the impracticability of enforcing common standards across system boundaries.[18]

Finally, they stated that each network would develop its own operational, diagnostic and maintenance features, which either could not be standardized because of proprietary computer programs and files (operational) of should not be standardized, because they would "stifle competitive introduction of potentially valuable services."[19]

Thus in order to determine whether the top 100 SMSA rule should remain, each of the three AT&T arguments should be examined. First, in their definition of EMS Xerox mentions "intercity common carrier communications service".[20] They do not specify an interstate or national EMS. However, in their petition they do refer to a need for a nationwide EMS and in fact propose such a system. The question, then, is do other EMS services using the 10.55 - 10.68 GHz band also have to be national?

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[18] Xerox Reply Comments, p. 3.

[19] *Ibid.* p. 6.

[20] Xerox Petition p. 1a.

In the 1934 Communications Act, part of the mandate included "...to make available...a rapid, efficient, nationwide, and world-wide wire and communication service."[21] However, this nationwide service was also to serve local and regional needs as well. The proposed XTEN system, although on a much smaller scale, is analogous to the Bell System in that it provides inter-state and local distribution services. The XTEN system (with its local distribution facilities) could serve the"market needs of a lesser geographical scope"[22] (as mentioned by AT&T). In addition such a nationwide system would offer the economics of scale advantage and a standardized system from coast to coast. Xerox emphasized the need for nationwide service and cited 850 business and government entities with at least 50 locations nationwide.

However, others have argued that regional networks can be established and later combined to form a national network. This may be easier said than done. In 1973 the Microband Corporation proposed a nationwide data network by combining independent stations into a network. Although they are still pursuing the idea , nothing yet has come of it. Also as cited earlier,[23] EMS

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[21] Communications Act 1934, p. 1.

[22] Supra. note 15.

[23] Supra. note 16.

networks will be much more difficult to connect than voice networks. Value added services (store and forward, message prioritizing, operational features, diagnostic features, maintenance features, encryption, message retrieval, etc.) make the interfacing of systems a difficult task indeed. As the industry develops, standards will hopefully be agreed upon, simplifying interconnection procedures. Yet,allowing regional EMS systems to develop with the promise of interconnection later to form a national network, will be a very slow process. National service is important and should be established as soon as practicable. In brief, nationwide networks will guarantee the establishment of regional distribution facilities, but regional networks will not guarantee national service in the near future.

Regional networks do have some value, however, and should not be necessarily precluded from using the 10.55 to 10.68 GHz band. However, national service should be given primary consideration. In the Xerox proposal ten 10 MHz channels have been proposed for local distribution (node to subscriber and vice versa). Of the ten channels the first five should be reserved exclusively for national systems and the remaining five can be used for either regional or national systems. Consequently, national concerns will not have to fight regional networks for frequencies in each individual city (in the first five channels). Moreover, regional systems will not be totally precluded from offering EMS services either.

The question here is how will the first five channels be reserved for national EMS systems. Xerox proposed a requirement to serve the largest top 100 SMSAs first as a means of guaranteeing a nationwide system. According to the Xerox market projections 64%[24] of the prospective user population will be served when the EMS is established in the top 100 SMSAs. AT&T argued that with "the wide dispersion of American industry to suburban and rural areas...the most significant markets may be in areas other than the top 100 SMSAs."[25] However, if the 100 SMSA rule was applied only to the first five channels[26] two things would happen. First, national service would be guaranteed and a majority of the user population would be served. In addition, the last five channels would be able to serve the remaining 36% (if a market exists) or for that matter any portion of the market where a demand exists (whether regional or national in nature).

AT&T also objected to the top 100 SMSA concept because it could create "insuperable financial and technical barriers". Yet with five channels not containing the top 100 SMSA rule these barriers would be significantly lessened. Furthermore, as Xerox points out,

> Moreover, the scope of existing and planned networks offering services similar to EMS supports the need for 100 city coverage as a practicable minimum. The Tymnet network provides service in 119 cities, Telenet in 82, and AT&T has stated that

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[24] Xerox Petition, p. 21.

[25] _Supra._ note 15.

[26] Xerox Petition, Figure 4, p. 28.

its ACS service will be offered initially in 100 cities.[27] Although no evidence was presented to show that these networks were serving the top 100 markets, in all probability they were, simply because a majority of users reside in them. Thus, if the first five channels are for nationwide service the 100 SMSA requirement would probably not present insuperable barriers. Any company proposing nationwide service should have the resources to serve 100 cities. As indicated above many existing networks serve close to 100 cities already. Furthermore, companies like Exxon, General Motors, and others would have the financial and technical resources to build such a system.

Therefore, the top 100 SMSA rule should be revised to read.

(a) Channels 1-5
The applicant *is financially* and *otherwise* qualified to render its proposed service in, at a minimum, the 100 most populous Standard Metropolitan Statistical Areas (SMSAs), as determined by the United States Census Bureau.

(b) Channels 6-10
The applicant is financially, and otherwise qualified to render its proposed service...[28]

Also, Xerox proposed "...that the assignment of channels to EMS networks for local distribution start at the center of each 50 MHz band and proceed sequentially as shown in figure 4."[29] The assignment of channels sequence should be changed to fit the above

[27] Xerox Reply Comments, p. 6.

[28] Supra. Note 13.

[29] Xerox Petition, p. 27.

rule change. Channels should be assigned sequentially from channels 1 to 5 for national service and 6 - 10 for regional service. This would enable the Commission to assign both regional and network channels simultaneously. Under the old proposal the five national channels would be established first and then the remaining five (which could be used for regional or national)would be assigned.

The division of the ten 10 MHz channels into five national and five national or regional channels will hopefully allow for the development of both types of EMS. With this plan market needs will be freer to dictate which services (regional or national) are more viable and necessary. Ultimately, demand will shape the form of EMS. Thus, the limiting of the top 100 SMSA rule to five channels (instead of ten) will serve the public interest by allowing for national and regional development of EMS in the 10.55 - 10.68 GHz band. In short, the public demand will determine the geographic scope of EMS services rather than an all encompassing mandate for national service as originally proposed by Xerox.

The Two Way Radio Specification. AT&T objected to the wording of the EMS definition proposed by Xerox. This definition was to be added to section 2.1 (Common Carrier Definitions) and section 21.2 (Domestic Public Radio Services). The objections were on the grounds that the definition would preclude comparable services in other frequencies and limit EMS to only radio communications (as opposed to wire, fiber optics, etc.). Since AT&T (ACS), IBM, COMSAT, Aetna (SBS) and other companies will offer EMS services, in other bands, using other transmission alternatives, this objection is to some degree justified. Thus AT&T proposed a revision to the Xerox definition.

> "Electronic Message Service" - a two-way domestic public communication service rendered on a common carrier basis between a fixed station and customer premesis for the delivery or acceptance of communications to or from subscribers to common carrier communications service.[30]

Xerox in its reply stated,

> ...Xerox did not mean to imply that other technologies should be precluded from providing electronic message services, in the generic sense. However, if the market need identified by

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[30]AT&T Comments, page 5 (The Word "Communication" was substituted for "radio").

> Xerox is to be met, it is imperative that the 10.55 to 10.68 GHz band be preserved for EMS networks as defined in the petition.[31]

However, it would seem that the inclusion of the Xerox definition would indeed preclude other than radio types of transmission. Thus for the benefit of all transmission technologies and EMS carriers, the AT&T definition should be substituted for the Xerox definition in section 2.1.[32] But, since section 21.2 contains definitions for Domestic Public Radio services, the narrower Xerox definition would be more appropriate in this case. In short, general common carrier definitions should include a more general definition of EMS and Domestic Public Radio services should include the more specific radio one.

Interconnection. In their comments on the Xerox petition Visions Ltd, and Southern Pacific Communications Company both raised questions about the age old interconnection issue. Specifically Visions stated,

> There must be a clear mandate from the Commission as to universal interconnection and equipment compatability so that users of any system authorized may employ any number of manufacturers' equipment. Whether this will entail licensing by Xerox or other authorized entities of patented equipment, Vision does not know at this juncture. However, there must be no artificial barriers created to other equipment usage.[34]

This fear stems from AT&T's long standing reluctance to provide

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[31]Xerox Reply Comments, p. 6.

[32]*Supra.* Note 30.

[33]*Supra.* Note 31.

[34]Visions, Ltd.'s Comments on Petition for Rulemaking, December 26, 1978, p. 2,(Comment (3)).

for interconnection. The Kingsbury Committment of 1913 and the Carterfone Decision[35] of 1968 were two landmark events which signalled the end of Bell's refusal to connect with other systems and with non-Bell terminal devices. One of the primary reasons for the Bell reluctance to interconnect resides in the fact that they were the suppliers of terminal equipment. Thus by allowing competition in the interconnection of terminal equipment, their revenues from the supply of that equipment would be eroded. Xerox, as a producer of the equipment which will be served by its network could potentially try to prevent interconnection for the same reason.

However, in their petition Xerox stated,

> XTEN and other carriers operating on the proposed EMS channels will provide telecommunications services pursuant to tariffs filed with the Commission. EMS carriers should be required to allow interconnection of their communications services with technically compatable terminal equipment, regardless of manufacture. Terminal equipment offered by common carriers should be at separately tariffed rates. In addition, carriers should make available interface standards to potential vendors of terminal equipment, and should be required to permit the resale and shared use of EMS communications services.[36]

Thus, in essense, Xerox will provide for interconnection, by supplying other vendors with their interface standards. However, these interface standards will be determined by Xerox and this will give them a competitive edge. They can design the network

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[35] U.S. Dept. of Congress, Office of Telecommunications, Federal Regulations Relevant to the structural Development of Telecommunications Industries, OT Report 77-135 by R.B. Johnson, (Washington, D.C.: U.S. Government Printing Office, Nov. 1977, pp. 28-29.

[36] Xerox Petition, p. 19.

interface standards to fit their equipment, while other vendors will potentially have to redesign their equipment in order to interface with XTEN. Yet is is doubtful that Xerox will attempt to make interconnection difficult. As other vendors produce more cost-effective terminal devices, Xerox will not want to preclude users from employing EMS services on the basis of the brand of equipment used.

Once interface standards are developed in this new industry it would be in the public interest to form an organization like the EIA (if not the EIA) to set industry standards for interconnection.

Also, a registration program like the one formed in Docket 19528 might be applicable. Since computer terminals and ancillary equipment are included in the registration program it is doubtful that Xerox and other EMS networks could prevent interconnection with users' equipment as long as that equipment is compatable with the network. Although Docket 19528[37] was formulated to protect networks from technical harm, it also has prevented networks from blocking interconnection as a means of protecting their own revenues from the sale of equipment.

Finally, although Xerox said it will provide for interconnection with terminal equipment, they did not mention other EMS systems. Moreover, although they said they would interconnect,

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[37] Second Report and Order, FCC 1976 C, p. 747 (Docket 19528).

Xerox put nothing in the rules concerning interconnection. Therefore, another rule should be added regarding interconnection. This rule should include other EMS systems as well as terminal devices, when technically possible. In short, the implementation of such a rule would hold Xerox to their word and avoid the age old problem of interconnection.

Limit of Service to Subscribers. In section 21.1101 part (b) of its proposed rules Xerox stated,

> (b) An applicant will not be eligible for authorization in this service unless it can be shown that at least fifty percent of the service rendered will be to subscribers who are not affiliated with or related to the applicant.[38]

Satellite Business Systems (SBS) took issue with this statement in its comments.

> ...*Aside from the inherent definitional* vagueness of this proposal, SBS questions the necessity for such a restriction for non-video related common carriage. If the applicant proposes to offer a valid common carrier service to the public pursuant to tariff, further restrictions on the identity of the customers appear unnecessary.[39]

Xerox undoubtedly put the rule in question into their proposal to demonstrate that they were in favor of competition. To support this rule Xerox cited the Commission's rationale for such a rule.

> While we may be belaboring the obvious, we wish to stress the importance to the public interest of not having common carrier frequencies taken up by persons serving principally their own business...It is important that the development of common carriers serving the public should not be blocked or inhibited by the presence in the common carrier bands of persons serving

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[38]Xerox Petition, p. 4a.

[39]Comments of Satellite Business Systems, November 29, 1975, p. 8.

> principally their own businesses who have other frequencies allocated for such activities.
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> Amendment of Parts 2, 21, 74 and 91 Docket No. 15586, 1, F.C.C. 2d 897, 901 (1965).[40]

Xerox also pointed out that other rules had similar limitations. They cited domestic public land mobile radio service (47 CFR 21.511) and point to point microwave service (47 CFR 21.700) as examples. In addition, multipoint distribution services also have such a limitation.[41]

Thus considering the Commission's rationale, Xerox was correct in placing this limitation in the rules. However, the SBS contention that the rule was inherently and definitionally vague[42] was correct. Does "fifty percent of the service rendered" refer to hours or the actual service offering (i.e. data only, teleconferencing only, etc.). Thus, a more specific rule should be used. The MDS rules would be a good model.[43] Therefore, restated the rule should read,

> (b) An applicant will not be eligible for authorization in this service unless it can be shown that at least fifty percent of the total hours of service rendered within any calendar month will be to subscribers not affiliated with or related to the applicant.

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[40]Xerox Reply Comments, p. 8.

[41]47 CFR 21.900 and 21.903 (b) (2).

[42]Supra. Note. 37.

[43]Letter from Microband to Charles Ferris concerning the Xerox Petition, February 6, 1979, p. 16.

Hopefully, by instituting this rule, the definitional vagueness can be removed.

The exclusion of other common carrier services from the 10.55 to 10.68 GHz band. In its comments AT&T stated,

> For example, there is no compelling reason to limit common carrier use of the entire 10.55 - 10.68 GHz band exclusively to EMS, as would be the case under Xerox's proposed rules. Other types of common carrier services may fill significant customer needs without technical interference with an EMS. It also seems unlikely that 10 common carriers will seek to provide EMS on a nationwide basis.[44]

In other words, AT&T feels that the band in question should be open to other uses besides just EMS. Xerox argues that their demonstration of a market need shows a requirement for at least 100 MHz of bandwidth.[45] Although the market need is merely an estimate, the band could potentially be totally occupied by EMS. To date, most common carrier services have not shown an interest in the 10.55 - 10.68 GHz band. If other services are also allowed to use this band they could at some future date preclude EMS expansion when space is needed. AT&T also mentioned the unlikeliness of 10 carriers entering the EMS market in the band proposed.[46] However, as Xerox pointed out,

> ...Should less than ten entrants actually apply, operating EMS carriers will ask for additional channels to meet public need. Thus, the market will not permit the frequencies to lay fallow.[47]

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[44] AT&T Comments, p. 4.

[45] Xerox Reply Comments, p. 12 (Also see chapter VII).

[46] Supra. Note 42.

[47] Xerox Reply Comments, p. 12.

The Xerox point is a good one with one exception. If only two or three carriers enter the EMS arena, and through channel expansion fill the entire 100 MHz then the interests of competition will not be as well served as if say ten carriers enter. However, making decisions on a "what if" basis is not sound reasoning. Only time will tell if this will occur. At any rate, based on the strong indications of EMS future growth, and the uncertainty of combination by a few carriers, 100 MHz should be allocated exclusively for EMS and 30 MHz should be allocated for local distribution and shared use. If a few carriers ultimately dominate the market or if for a period of seven or eight years parts of the bandwidth do remain unused, then the rules will have to be changed. But for the present, this new concept should be allowed to develop.

Required Demonstrations of technical competance, financial qualifications and a seven year completion deatline. The Rochester Telephone Company strongly objected to the Xerox requirements for technical competance, financial qualifications and a completion timetable.[48] The Rochester objections are to a large extent justified. A financial qualification is the only really justifiable requirement. As long as a company can show that it has enough money to enter the market no other requirements are needed. This rule is necessary, so that companies don't tie up spectrum while they are trying to find backers. However, the other requirements are totally unnecessary. Any company with the financial

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[48] Comments of the Rochester Telephone Co., pp. 2 & 3.

resources to invest in such a venture will surely have planned the system before ever applying for a license. All that demonstrations of system configurations, technical competence, 100 city service and time schedules would do is, burden the already overworked FCC and give competitors a chance to comment on the proposals (thus delaying implementation even further). If an entrepreneur has not adequately planned, the market forces will drive him out. If he has planned he will survive. Thus, with the exception of a financial showing the other matters are a waste of time and will unnecessarily delay entry of competition. However, as the spectrum is used up and two companies are competing for the same band, this could then become a basis for deciding who will get the license. But the service is new and only a financial showing should be required at the present time.

Some final remarks on Anticompetitive Allegations.

In a letter to Charles Ferris, Microband stated,

> Xerox itself proposes various safeguards to prevent potential abuse. (re: Anti-Competitive Concern) It proposes separate corporate identities, favors no restrictions on resale of services and promises interconnection with all forms of equipment. The safeguards proposed by Xerox are consistent with, though perhaps less extensive then, those imposed by the Commission on other companies.[49]

Xerox did to a degree try to demonstrate a concern for competition. However, some of their proposals would truly reduce competition. Although competition is important, the most important factor is the public interest. Thus, while many of the comments

[49] Microband Letter to Ferris, p. 9.

alleged anti-competitive proposals, the most important issue, the public interest, was seldom raised. For this reason, this section (of this chapter) has focused on the public interest rather than strictly competition. Thus, it is hoped that the proposed rule revisions and clarifications will serve both the public interest and competition. However, their primary focus has been on the public interest.

Comments Designed to Discourage EMS Services of the Type Proposed

In its comments GTE was the one firm that urged "...that the Commission not adopt the rule changes as proposed."[50] Interestingly enough in April an EMMS article, using IRD estimates predicted that GTE had an apparent willingness to invest one hundred million dollars in Management Action Systems (EMS).[51] Thus GTE's efforts appear to be an action to hold up a potential competitor (Xerox). Later GTE stated,

> ...we urge that the Commission obtain from Xerox the type of data that can only be obtained from operating a developmental system (e.g. performance standards, market data, technical criteria, frequency coordination, interference potential, etc.) before radio frequencies are allocated to a new radio service. This approach will provide the Commission with actual hands-on technical data and a clear demonstration that the pieces of the whole can be assembled into a truly feasable system. Such data are, in our opinion, superior to written comments and required before a frequency allocation is made.[52]

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[50]Comments of GTE Service Corporation, January 8, 1979, p. 1.

[51]Goodby "Management Information System". Hello "Management Action System", EMMS. Vol. 3, No. 8, April 15, 1979, p. 5. (Copywrite applied for.)

[52]GTE Comments, p. 3.

GTE further cited the "development of cellular mobile"[53] as an example of such a proceeding. Unlike the Xerox proposal, the cellular mobile developmental license issued under part 5 of the Commission's rules was for a relatively new technology. The Xerox plan uses established technologies in a unique new combination. Thus a developmental license is not necessary and would merely serve to impede the Xerox efforts. This is an attempt by GTE to effectively remove competition in the EMS arena. In its reply comments Xerox pointed out,

> In Docket 18262 the Commission reallocated the spectrum before the developmental programs were ordered. However, during the rulemaking, it appeared that "considerable additional work must be done before standards may be prescribed, especially standards which would assure compatability nationwide" Land Mobile Service (Docket 18262), 51 FCC 2d, 945, 953 (1975). The need for developmental standards for cellular mobile telephone service was dictated by the Commission's decision to restrict service to a single system in each locality and to assure that mobiles from different cities could operate in all systems.
>
> This approach is not necessary or appropriate for EMS. As indicated Xerox proposes that spectrum be made available for up to ten competing systems. If the Commission were to establish unduly restrictive technical standards for operation of EMS systems, the benefits of competition might well be precluded.[54]

GTE also suggested in their conclusion,

> ...In the alternative, if the Commission determines that the Xerox XTEN proposal requires further study, GTE then recommends that a Notice of Inquiry be adopted and the questions of a need for the service proposed; markets to be served, bandwidth

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[53] Ibid. p. 3.

[54] Xerox Reply Comments. p. 13.

> allocations, need to serve the largest 100 markets in a time certain; and technical effectiveness of the proposed system all to be investigated.[55]

In reply to this Xerox stated,

> Similarly, issuance of a Notice of Inquiry, followed at a later date by a Notice of Proposed Rulemaking, is completely unnecessary and would merely add at least two more rounds of comments and many months of delay to the proceeding...Moreover, an inquiry would not adduce evidence more comprehensive or enlightening than that which will be developed in the rule making.[56]

Thus the GTE proposed inquiry is yet another attempt to delay a potential competitor. This in combination with the proposed experimental license is an unjustified attempt by GTE to preclude competition from the EMS market (a market which GTE has entered with its Value Added Carrier - Telenet). Thus in terms of the issues raised here XTEN should be allowed to proceed on a non-experimental basis and the Notice of Rulemaking should proceed without first having a Notice of Inquiry. If the XTEN system is not feasible, the marketplace will take care of it.[57] If it is feasible then it will survive and prosper.

<u>Multipoint Distribution Systems</u>

Two MDS interests filed comments on the Xerox petition. Microband, the largest MDS Multiple Systems Operator (MSO) and Visions, the largest MDS user both showed interest and concern over the XTEN plan. Also the Common Carrier Association for

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[55]GTE Comments, pp. 4 & 5.

[56]Xerox Reply Comments, p. 13.

[57]As in the case of DATRAN, 1976.

Telecommunications, the trade association for 25 MDS operators expressed its concern. This interest and concern stems from essentially two facts. First, Xerox used MDS to develop the technology for XTEN. More specifically, as Mark Foster of Microband indicated,

> "Xerox personnel spent considerable time" over the past year working with Microband executives to develop the XTEN concept.[58]

Secondly, MDS operators feel that they can provide similar broadband digital communications using the 21.50 to 21.62 GHz band. At the present time MDS is used primarily as a vehicle for pay television. However, as early as 1975, the MDS industry has been talking about a nationwide network.[59] Eventually, MDS will probably provide daytime data services as well as evening pay television services. Thus MDS comments on XTEN consist of three types. First, as evidenced in the Visions and CCAT comments, MDS has already provided for local EMS services and should not be overpowered by Xerox.

> The association (CCAT) called the XTEN proposal "the first steps of corporate giants hoping to secure a solid position" in nationwide telecommunications for which MDS was created.[60]

In addition to these fears MDS operators are quick to point out that at 100 watts their signal can reach 40 - 45 miles, while the

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[58] "MDS Operators Rap Xerox Net Proposal", Electronic News, January 17, 1979, p. 32.

[59] Microband Promotional Flyer, 1975.

[60] Electronic News, January 17, 1979, p. 25.

0.5 watt signal in the 10.55 - 10.68 GHz band can only reach 6 miles. This is, however, discounting the cellular distribution scheme.

Secondly, some MDS operators (Microband and affiliates in particular) claim that they can provide a nationwide network.

> We are far along in the establishment of a nationwide network of interconnected MDS stations which, notwithstanding our comparative lack of capital...should put us in operation in 100 markets long before the Xerox proposal is even acted on. Mr.Franco said.[61]

The lack of capital is a significant matter indeed. MDS, a relatively new industry, simply does not have the money it would take to provide the software and hardware features of the proposed Xerox network. Also Mr. Franco's statement relies on the assumption that MDS operators will get blanket authority for two way transmission [62] from the FCC.

A third type of comment proposes using an MDS channel for local distribution and one of the proposed 10 GHz EMS channels for a return channel. Xerox opposed this vehemently in their comments on the grounds that: range advantages would be offset by line of sight obstructions and multipath interference; reuse of frequencies would not exist; and a 2/10 GHz subscriber transceiver would be too costly for the subscriber and ultimately the public.[63]

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[61] Ibid. p. 25.

[62] At present Channel 1 (6 MHz) and Channel 2A (4 MHz) are existing or available in all markets. Channel 2 is available only in the top 50 markets.

[63] Xerox Reply Comments, p. 16.

In addition to the problems cited above it must be noted that in all but the top 50 markets one 6 MHz channel and one 4 MHz channel are all that are available for MDS. Thus MDS, at present, doesn't leave much room for competition in any given market. On the other hand, MDS could have a definite future in providing city-wide broadband communications channels. Since they can perform this function, they should be allowed to interconnect with the XTEN type EMS systems. This could offer another viable alternative to the cellular approach and thus serve the interests of the public and competition. However, it is doubtful because of the current financial and regulatory status of MDS that they could provide a nationwide network. Therefore, the MDS objections and concerns should not stand in the way of the Xerox EMS 10.55 - 10.68 GHz frequency allocation.

Concluding Comments

It is therefore our opinion that the Xerox request for the allocation of the 10.55-10.68 GHz frequency band for EMS should be granted. However, the following changes should be made. First the more general definition of EMS should be used in the general rules. Secondly, the nationwide EMS definition should be placed in section 21.2 under Domestic Public Radio services. Third, the top 100 SMSA requirement should be modified. Fourth, demonstrations of technical competence, system configuration and a construction timetable should be removed. Finally, a more specific definition (as proposed) should be placed under section 21.1101 (b) in reference to service to affiliates. Once these changes have been made and the other proposed rules have been adopted, Xerox and others should be allowed to apply for operating authority under the new EMS service.

CHAPTER X

REGULATION

Introduction

Today there is little disparity in the regulation of common carriers. Most have to adhere to the same regulatory scheme whether they are monopolies or competitors. XTEN and other EMS services also will likely have to adhere to these rules. The question is should they be regulated in the same manner as monopolies?

In order to examine this question this chapter will be divided into three parts. Fist, the rationale and major historical developments in the common carrier industry will be explored. Second, the ideal form or regulation of a competitive EMS will be discussed. Finally, an examination of the conflicts between present regulatory schemes and competitive common carriers will be conducted and a recommendation will be made.

A History of Regulation

The common carrier industry initially developed around one central company. AT&T and its subsidiary Western Electric were for all points and purposes the Common Carrier industry, until after the Second World War. The primary reason for the Bell system's dominance resides in the relationship between the FCC's 1934 mandate and the concept of natural monopolies. Thus, the first step in examining the development of American Common carriers is to examine the relationship between the regulator and the natural monopoly.

The Rationale for Regulation.

The FCC was established in 1934 to perform essentially two functions. The first was to insure that spectrum, a scarce public resource was used efficiently. A second mandate was stated on the first page of the 1934 Communications Act.

> Sec. 1. For the purpose of regulating interstate and foreign communications by wire and radio so as to make available... a rapid, efficient, nationwide and world-wide wire and communication service with adequate facilities and reasonable charge...[1]

AT&T had been in operation 35 years prior to the Communications Act and was one of the most likely candidates to fulfill the FCC's mandate. *Thus the conceptualization of the telephone industry as a* natural monopoly was eventually born. A natural monopoly was believed to be more efficient and less costly than competition for several reasons. First, duplication of telephone services was deemed inefficient. Because of large economies of scale one company could produce service at a lower average cost than two competing in the same area. Secondly, a monopoly would be more inclined to provide universal service. AT&T served the low profit, less dense routes, because they were also given all of the lucrative business in the high profit markets. Whereas under competition, companies would operate in the lucrative markets, ignoring the less

[1]The Communications Act of 1934. With Amendments and Index Thereto, January 1969, p. 1.

profitable more rural areas (where the capital investment per subscriber was much higher). Thus monopoly allowed subsidization of the weaker markets by the stronger markets. Thirdly it was believed that one carrier could set the same standards for the entire system. Easy access, reliability, efficiency, lower customer costs and a more rapid development of the network were advantages offered by a natural monopoly. Conversely, with competition, the interconnection of technically different networks, the possibility that subscribers would have to have more than one phone to communicate over different networks and the problems in planning a nationwide network were seemingly insurmountable.[2] In return for the natural monopoly advantages the Commission through regulation prevented the entry of other competitors. Furthermore, competition in the private sector was considered by many to be destructive in some cases.

> ...In other contexts, these (economists and lawyers in the 1920's and 1930's) and other observers were pointing out that some of the same factors that made competition infeasible and potentially destructive among public utility companies -- notably economies of scale and heavy overhead costs - were widespread in the unregulated industries as well. This led some of them to call for the introduction of comprehensive regulation as a means of eliminating the wastes, instabilities, and social costs imposed by competition...[3]

Thus the advantages of cheap, efficient, universal, nationwide service for the public and the detrimental effects of destructive

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[2]Alfred E. Kahn, The Economics of Regulation: Principles and Institutions, 2 vols. (New York: John Wiley and Sons, 1971), Vol.2 pp. 127 & 128.

[3]Ibid. Vol. 1, pp. 9 & 10.

competition led to the formation of the natural monopoly concept and regulation by the FCC to preclude competitors.

Historical Developments.

The FCC was not the only entity to regulate the industry. Since a telephone system operates on an intra state as well as an interstate basis, the PUC's emerged and also protected and regulated the AT&T facilities. Thus the FCC regulated interstate rates and the PUC's (and other state and local agencies as well) regulated intrastate rates. Out of this dual regulation a difficult issue arose. The local telephone central office and other facilities offered interstate toll services and intrastate services. Subsequently a "separations" procedure was developed to separate state and local costs from national costs. This procedure first received attention in 1913 with the Minnesota rate cases. But, it was not until 1930 that the problem was considered by the courts in terms of telephone rates. Joint FCC-NARUC committees began work on the separations procedure in 1941 and have constantly dealt with the problem since then. In 1947 the station to station method was adopted, but the separations procedures are still not entirely resolved.[4] The reason separations is so important is twofold. First since inter and intra state regulation is rate based, separations is the only way for state and federal regulators to set rates based on return. Secondly, since local telephone service is to some degree subsidized by business and toll services these two

[4]NARUC-FCC Cooperative Committee on Communications, Separations Manual, 1971, pp. 5-8.

sources' revenues must be separated from those of the local service which they are to subsidize.

The allocation of revenues to inter and intrastate services is the settlements procedure. This procedure developed informally along with the separations concept. However, it was not really an important issue until 1913 when the Kingsbury Commitment enabled independent phone companies to interconnect with the Bell system. From 1913 until 1934 several settlement procedures existed. Yet the lack of standardization industry wide was a problem. In 1934 some of the Bell and independent companies started using A and B schedules of commission. These varied with the average revenue per message in each of the independent companies areas. From 1941 to 1946 several changes were made in settlements procedures. A and B schedules were changed to, among other things, be consistent with the separations station to station principle. However, most of the data used to determine the settlement schedules was based on Bell System cost experiences. Thus in 1946, the United States Independent Telephone Association (USITA) and the Bell System negotiated. During these negotiations Bell requested industry cost data from the independents. In accordance with this request USITA worked on settlements procedures to be used by the independents. This work led to more comprehensive and more standardized settlements procedures which were instituted in 1952. Throughout the 50's and 60's Bell and USITA conducted more studies and worked on refining the settlements procedure.[5] In addition, Bell has a similar "settlements"type of procedure for dividing intra and interstate revenues within its network. This procedure is called division of revenues and is essentially the same thing as settlements. Thus the settlements procedure developed with the separations procedure and enables the subsidization of local service by business and toll services.

The separations procedure simultaneously shows the dependence and independence of the FCC and individual public utility commisssions. Together they worked out the separations procedures and separately they determine the rates for inter and intra state services.

However cooperation between the two regulatory bodies has not always existed.

> ...In particular, the split between federal and state jurisdiction has posed difficulties. Fearing that competition will force an increase in intrastate telephone rates, state utility commissions generally have opposed the FCC's decisions and continue to reflect the philosophy embodied in the three propositions noted at the beginning of this paper.[6]

Perhaps the most recent and classical example of this was the "Telerent Decision" concerning the interconnection of customer provided equipment.

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[5]USITA "A History of Separations and Settlements" Telephone Cost Separations United States Independent Telephone Association, (Vol. 1, Ch. 2, June 1971) pp 18-27.

[6]Leland L. Johnson, "Monopoly and Regulation in Telecommunications," Communications for Tomorrow, edited by Glen O. Robinson (New York: Praeger Publishers, 1978) p. 146.

> ...Decisions of the North Carolina Utilities Commission and the Attorney General of Nebraska, if carried out would have prevented interconnection of customer provided equipment to telephone systems in those states. In its Telerent Decision, the FCC concluded that it did have preemptive jurisdiction over terminal equipment - a decision that has been upheld by the courts.[7]

Consequently, the FCC can preempt state regulations when a conflict of interests is involved.

After the Second World War two technologies changed the natural monopoly structure of the industry. First, microwave, satellites and other communications technologies emerged. Individual entrepreneurs began to realize that reduced costs in these technologies offered a chance to compete with established carriers.

> ...numberous large commercial, industrial and governmental entities applied to the FCC for the necessary authorizations. Supporting their petitions were various manufacturers of electronic equipment, who were anxious to get into and develop that rich market, from which they remained essentially excluded if the field were left entirely to common carriers and their own financially affiliated, virtually exclusive manufacturing subsidiaries such as Western Electric.[8]

At first, the Commission stayed with the natural monopoly principle and only temporary licenses were issued for the interim of proceedings. However, the industries involved eventually persuaded the FCC to allow the entry of private systems. This was the Above-890 Decision (above 890 MHz) of 1959 and 1960. Although Bell argued that "cream-skinning" would occur and prohibited connection to the network (to protect if from technical harm), the FCC authorized

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[7] Ibid. p. 146.

[8] Kahn, Economics of Regulation, Vol. 2, p. 129.

entry. AT&T quickly provided three services (WADS, TELPAC, WATS) very similar to those proposed by the Above-890 advocates.[9] However, This was the beginning of the end of Bell's almost exclusive monopoly.

While all of this was happening the computer industry was growing rapidly. This second post war technology created a new communications need - mainly that of data transmission. Thus digital technology was required for transmitting binary encoded data. The massive telephone network was an analog facility and although modems could be used to convert from a digital to an analog mode and vice versa, strictly digital communication facilities were the best transmission mediums.

This development coupled with MCI's proposal for a cheaper private line service ultimately led to the Specialized Common Carrier Decision of 1971.[10] Competition had begun in the common carrier industry. MCI and DATRAN entered the market. MCI was a private voice system while DATRAN was a digital non-voice transmission system.[11] In the next few years the FCC authorized domestic satellites (Domsat 1972) and value added carriers (1973). Thus,

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[9]U.S. Dept. of Commerce, Office of Telecommunications Federal Regulations Relevant to the Structural Development of Telecommunications Industries, OT Report 77-135 by R.B. Johnson (Wash. D.C.: U.S. Government Printing Office, Nov. 1977, p. 20.

[10]Ibid. pp. 22-23 (MCI was granted permission to construct and operate a private microwave system between St. Louis and Chicago in August of 1969). Infra., Note 10.

[11]Dixon R. Doll, Data Communications (New York: John Wiley and Sons, 1978) p. 42. (Datran went out of business in 1975.)

competition from the specialized carriers has grown and developed considerably since then in the provision of private line services.

While the specialized services were developing, another set of events were also simultaneously changing the common carrier industry. In 1949 the U.S. Department of Justice issued an anti-trust suit against AT&T. This was settled with the 1956 Consent Decree. Section five of the decree stated,

> Section V: Prohibits AT&T and its subsidiaries (Western Electric) from any business other than common carrier communication services with a few minor exceptions...[12]

AT&T was therefore prohibited from getting into other than common carrier fields. However, as data communication technologies developed the distinctions between communications and data processing became increasingly vague. With the advent of computer controlled switching and in light of the Consent Decree the FCC initiated the first Computer Inquiry in 1966. Since the FCC's authority did not allow them to regulate data processing a distinction had to be made. In order to solve this dilemma the Commission defined two types of service. The first was a "Hybrid Data Processing Service". Its primary purpose was data processing and message switching was only incidental. The FCC did not assert jurisdiction in this area. On the other hand, "Hybrid Communication Services" had primarily a message switching function and a incidental data processing capability. This was a regulated service.

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[12] R. B. Johnson Federal Regulations Relevant to the Structural Development of Telecommunications Industries, p. 32, U.S. v. Western Electric, No. 17-49 (D.N.J., January 24, 1974).

A second important reason why the FCC wanted to separate these services was cross subsidization. The Commission feared that AT&T might subsidize non-regulated data processing services from their regulated common carrier services. If AT&T did this (as they have in the past), then they could undercut other prices in a maneuver called "predatory pricing". Besides being anti-competitive the Commission feared that cross subsidization could "...result in burdening or impairing the carrier's provision of its other unregulated services..." [13] Thus cross subsidization was also an important consideration in this matter. The Commission proposed that Common Carriers offer Data Processing Services only through separate corporate entities. AT&T, however, could not do this as a result of the Consent Decree.

The Second Computer Inquiry was started for the following reason.

> 10. Technical and market developments since our decision in the first Computer Inquiry are such that Section 64.702 appears to be an inadequate regulatory device for coping with current service offerings...
>
> 11. The versatility of the user terminals which are available today further complicates our efforts to establish regulatory boundaries. Microprocessor technology has clearly made it possible for terminals to automatically perform many processing operations which they previously performed poorly or not at all.[14]

In this Inquiry and rulemaking the Commission defines

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[13]Federal Communications Commission, Tenative Decision and Further Notice of Inquiry and Rulemaking, Docket No. 20828, July 2, 1979, p. 2.

[14]Ibid. pp. 5 & 6.

essentially three categories of service. The first two, voice and non-voice are to be offered by common carriers and will be regulated. The third service, enhanced non-voice, must be offered by a separate resale subsidiary. Resale is however a type of common carriage. Thus AT&T could enter this field and not technically violate the consent decree. However, the degree of separateness was not clearly identified. Consequently, cross subsidization problems could result. However, the inquiry is not over with and this issue may be dealt with at a later time. But the rule as it stands would allow AT&T entry into this competitive field.

This section has presented several facets of regulation. First the Natural Monopoly concept and other rationales for regulation were discussed. Then the historical development of competition was examined. In the context of these two areas, some of the more important common carrier issues were examined.

The Extent to Which EMS Systems Should Be Regulated

In this section of the chapter, the Xerox proposal for a nationwide EMS will be examined in conjunction with the material discussed above. Recommendations will be made concerning how the system should be regulated or deregulated.

When the 1934 Act was formulated AT&T was in essence a monopoly. However, with the communications advances of the last thirty years, AT&T's inter state services are by no means natural monopolies. XTEN is a combination of these technologies (eg. microwave, satellites, cellular radio, and computer switching and control). It will be able to provide a non-voice (with the exception of digitized voice for teleconferencing), digital message service. AT&T's ACS will provide some similar services, but the speed won't be nearly as fast as XTEN (9.6 kbls vs. 256 kbls).

The important criteria in determining how Xerox will be regulated is the rationale for regulation. As mentioned earlier the Commission's mandate was best met (at that time) by the characteristics of a natural monopoly as opposed to competition. Although, in the local loop market, AT&T is still a monopoly, its interstate service is subject to a fair amount of competition. In addition to this fact, Xerox will provide local distribution functions as well. In the 1978 book Communications for Tomorrow one author stated,

> Today the Bell System provides about 83 percent of the nation's telephones covering 41 percent of its land area, while 1,600 independent telephone companies serve the remainder![15]

Thus Bell still has a sizable portion of the business. It also must be remembered that the 1600 independent phone companies must interconnect with Bell. Thus AT&T has immense monopoly powers in some areas. Conversely, Xerox does not have any monopoly powers.

Thus the question arises. Should Xerox and other EMS competitors be regulated as monopolies? The answer is probably not. Granted, the technical rules and basic policy rules (discussed in Chapter VIII) should be enforced, but Xerox and other companies in the EMS field should be allowed to compete. In short, the monopoly

[15]Leland L. Johnson, "Monopoly and Regulation in Telecommunications", Communications for Tomorrow, p. 128.

rationale for regulation is not valid in the case of the proposed EMS. Therefore this service should in many respects be deregulated.

The EMS service is essentially private in nature. Its use will benefit the public, but indirectly. Reduced business costs will reduce waste and in turn benefit consumers in terms of prices, products, services and possibly the information economy. In this private type of service,competition and demand will determine where service is instituted. Universal service to every area should not and can not be the responsibility of any single EMS carrier. This in combination with the fact that Xerox will not use the public telephone network would indicate a different federal and state regulation scheme. Unfortunately, however, Xerox will probably be regulated by state Public Utility Commissions as well as the FCC. This is a result of the fact that Xerox will provide local distribution services. Also, PUC regulation will stem from the fact that EMS is a public utility as defined by Black's Law Dictionary.

> ...To constitute a true "public utility," the devotion to public use must be of such a character that the public generally, or that part of it which has been served and which has accepted the service, has the legal right to demand that the service shall be conducted, so long as it is continued, with reasonable efficiency under reasonable charges.[16]

As a consequence Xerox could be required to go through the separations procedure. Since other specialized carriers are also required to participate in this process, EMS systems should also. This is the equitable way of doing things. However, the Separations

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[16] Henry Campbell Black, Black's Law Dictionary (St. Paul, Minn.: West Publishing Co., 1968) p. 135.

procedure should only be used to determine how EMS revenues should be applied to the settlements procedure. Xerox and other EMS carriers should not be regulated in the same way a monopoly is. Since these carriers will be in competition, State PUCs should deregulate the EMS systems as much as possible.

However, Xerox and others could run into local problems. Don Franco, the president of Microband, in a letter to Charles Ferris recognized the problem of building access. The Xerox system will require the wiring of buildings. At the present time only the Bell System has unrestricted access to buildings. Either this unrestricted access should be extended to include other carriers or the Bell system should be required to "provide internal distribution on a reasonable and non-discriminatory basis."[17] The extension of unrestricted access would probably be the most equitable and efficient way of handling these matters. Thus limited state and federal regulations should be the only kind imposed on Xerox, with one exception. If in the process of connecting with other local EMS systems, Xerox uses the Bell network then they should be required to contribute to the settlements pool. Otherwise, their non-voice business service should not be required to do so, because they are not in competition with the local, public, voice distribution system.

The separate resale subsidiaries rule should also not be applied to Xerox and other competitive EMS services. Although

[17]Letter from Microband to Charles Ferris concerning the Xerox petition, February 6, 1979, pp. 13 and 14.

Xerox will be offering enhanced non-voice and common carrier services they will not be cross subsidized. The primary rationale for the computer inquiries was cross subsidization avoidance. However, since Xerox does not have monopoly powers in its manufacturing, common carrier and value added service areas, cross subsidization is an impossibility. Thus the separate resale subsidiary rules should only apply to companies with monopoly powers.

Xerox should, however, be required to interconnect with other EMS systems when technically possible. As previously mentioned, Xerox said they would interconnect with other terminal devices, but did not mention other EMS systems. Both types of interconnection should be required to enable subscribers of separate EMS systems to communicate with each other. When competition exists it should serve the public interest. If the refusal to interconnect hurts the public interest then cooperation should be substituted for competition. Therefore, interconnection is in the public interest. This combination of local and national EMS systems is in the interests of public and private institutions as well. It will enable freer competition and more efficient communications for subscribers.

Traditionally, however, the FCC in the interests of fairness has applied rules aimed at controlling monopolies to the specialized carriers. This practice is not really as fair as it may seem. Although Xerox, like other specialized common carriers, will not be rate base regulated they would have to file tariffs. This is an unnecessary practice, because the market would regulate prices.

If a price is too high then the users would turn to another competitor. Thus the filing of tariffs is unnecessary and should be done away with. Specialized carriers also have to file for 214 construction permits to make changes in existing facilities. The purpose of this is to prevent monopolies from making unnecessary improvements to inflate rate bases. A competitive carrier would not "gold plate" his facilities, because an unnecessary raise in rates would lose customers. Thus more likely than not EMS carriers will make only necessary improvements and should not be required to go through the laborious 214 process. A competitive company is faced with a very inelastic demand curve. Whereas, in the provision of local phone service, a monopolies demand curve is very elastic indeed. Thus, it would not be in the companies' own self interests to charge too high of a price. Therefore, XTEN and other EMS services should not be required to file tariffs or obtain 214 construction permits.

Also it should be noted that Xerox will not wastefully duplicate any of the Bell System's functions. In fact, here competition has supplied what a monopoly did not. Consequently, EMS as proposed by Xerox should be left competitive.

Conflicts Between the Present Regulatory Structure and Competition

The proposals above for partial deregulation of the Xerox EMS service will likely not come to pass in the near future. Although the FCC in the past has tried to forbear in its regulatory duties (to allow competition to govern) it has not been entirely successful. In 1953 the Supreme Court's "Three Circuit Case" set a precedent in this area.[18] It demanded that the FCC reason its way to the conclusion that competition is in the public interest before it forbears. Then in the 1974 Land Mobile Service case another distinction was made. On January 5,1976, the Court of Appeals ruled in favor of the FCC decision, but made the following distinction. If a service was offered to anyone at reasonable rates it is a common carrier and must be regulated. On the other hand, if the service is not offered to everyone then the FCC does not have to regulate it.[19] Thus in terms of Xerox and other EMS systems the Commission must regulate. However, after careful reasoning it can determine that competition is in the public interest.

Unfortunately, under the present circumstances Xerox and other EMS carriers will have to abide by the monopoly oriented rules. Thus, at the present time Xerox will have to form two separate subsidiaries (see figure below). One will be a regulated

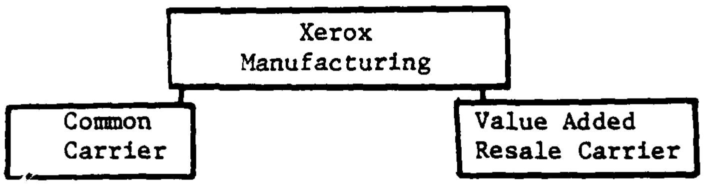

Figure 10 - 1

[18]James Cranford Criner, An Analysis of Policy Options in the Regulation of Value Added Network Services, Unpublished PhD Dissertation, George Washington University, Feb. 21, 1977, pp. 146-147 (FCC v. RCA Comm. Inc., 346 US 86 (1953)).

[19]Ibid. pp. 152-154 (Nat'l Ass'n of Regulatory Util. Comm'rs. v. F.D.D., F2d (5 January 1976).

common carrier facility and the other will be a value added, non-regulated, facility. This forced separation and the vagueness of the separation of subsidiaries (from the parent company) clause are wasteful when applied to a competitive entry. Thus Xerox and others will be unfairly handicapped by a procedure that shouldn't apply to them anyway.

It would appear that the solutions to this problem reside in the legislatures. The two House Bill rewrites of the Communications Act were deregulatory in nature. This was a very good idea. Since monopoly is absent and market place forces are present, regulation is not that necessary. In fact it wastes the Regulatory Commission's time and the business' time. Thus Xerox's and other EMS companies interests will best be served by deregulation through a rewrite of or amendments to the 1934 Communications Act.

Therefore, we feel that in the interests of efficient, nationwide EMS services that the proposed EMS industry be exposed to as little regulation as possible. Regulations designed to control the excesses of monopolies should not be applied to competitive entities.

CHAPTER XI

SUMMARY AND CONCLUSIONS

There is little doubt that a need exists for more efficient and cost effective communication systems. This need is evident from the inadequacy of telephone company switching equipment, in terms of capacity, speed, quality and reliability, to the lack of standards in both equipment and line control procedures. Most of these problems can be remedied through the use of integrated networks. Some of the major providers of these integrated networks are AT&T, SBS and Xerox. Each has gone after a specific market. Some EMS services already exist but each is unique in its service offerings.

The uniqueness of XTEN lies in the fact that they will provide primarily a digital non-voice service, designed to facilitate inter-office communications. The non-military portion of the Federal Government and industry will undoubtedly use XTEN types of services to meet their needs. With some modifications and different security measures, this type of system could also be employed by the military.

The local distribution system of the proposed EMS is unique in that it circumvents the Bell System. This will also save business consumers money. Since the proposed EMS systems will provide lower cost, more capacity and higher speed services it is probably the best service to put in the 10.55 to 10.68 GHz band. However, some of the rules proposed by Xerox should either be changed or limited.

The 100 top SMSA rule, demonstrations of technical competence, time tables, and demonstrations of system configurations should be modified or dropped. Experimental licenses should not be granted in lieu of regular licenses. The definition of EMS should be less specific in the general rules and more specific in the Domestic Public radio rules.

As a competitive industry, monopoly oriented policies should not be applied to EMS. Rather, the competitive forces of the marketplace should be the determinants of rates, entry, and the decision of whether or not to offer data processing services. Separate subsidiaries are not needed in the competitive marketplace. Under the present rules, however, the Commission would have a difficult time deregulating. Thus, new legislation should be drafted to release the FCC from some of its regulatory burdens. The FCC should regulate competition only when abuses occur that the market cannot handle. Otherwise the marketplace forces should regulate EMS. Experience has shown that innovation advances more rapidly in an environment of competition than monopoly. Therefore, the old natural monopoly rationale for regulation does not apply to EMS. Consequently, our recommendation is that the EMS be given the spectrum it needs and that through legislation the FCC will be allowed to deregulate and let market forces take over. This we feel will truly be in the public's interest.

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APPENDIX A

Time Division Multiple Access

Time Division Multiple Access (TDMA) is a technique by which several communicating earth stations share a given satellite transponder and transmit pulse bursts at regulat intervals.[1] The transmission times of the stations are staggered relative to each other, such that a burst of data from one station does not overlap, in the transponder, with bursts transmitted from another station. (See Fig. A-1).[2]

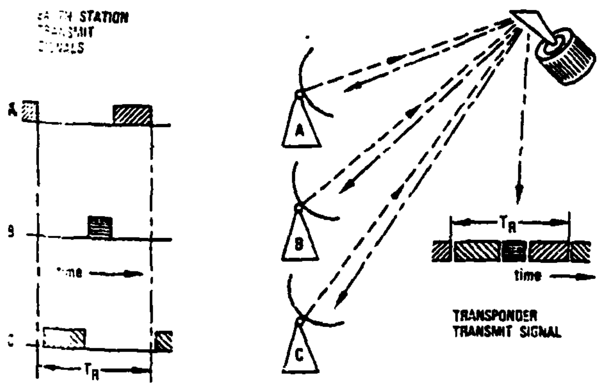

Fig. A1 Time division multiple access principle.
A,B, and C are participating earth stations.

Most present satellite systems use frequency division multiple access (FDMA). This means the transponder is shared on a

[1]H. Haberle, and F.T. Knabe, "Time Division Multiple Access to Communications", Electrical Communication Vol. 48, No. 1 & 2, 1973, ITT p. 93.

[2]Ibid.

frequency allocation basis. With FDMA the satellite transponder capacity cannot be fully utilized, since capacity decreases as the number of accessing earth stations increases.[3]

The advantages of TDMA are,

1. The output amplifier, because only one carrier can transmit through the satellite at a time, can operate at maximum level. Thus full power will be utilized.

2. TDMA can be easily adapted to changes and growth in traffic patterns. This is possible since the capacity of any station is proportional to the allocated time it may access.[4]

For the transmission of information, the satellite systems utilize pulse code modulation (PCM) with a sampling rate of 8KHz. This allows each voice channel to be sampled every 125 microseconds with frame lengths of 125 microseconds or a multiple thereof.[5] Earth stations transmit their information only during time slots assigned.

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[3] Ibid.

[4] Andrew Werth and Paradman Kaul, "TDMA provides a Solution for Multi-user Satellite Network", Communication News (March 1979) p. 62.

[5] H. Haberle, and F.T. Knabe, "Time Division Multiple Access to Communications", Electrical Communication Vol. 48, No 1 & 2, 1973, ITT p. 93.

APPENDIX B

DOCUMENT DISTRIBUTION

Document Sending Services (256 Kbps) Entry Device: Network recognizes the wide-variety of word processing systems, optical character readers and raster scanning terminals; provides conversion for communication between many incompatible terminal devices.

Document Identifier: Identifier is added once document has been completely entered into the system i.e. data, time stamp, document identification number.

Sending Priorities:
Immediate-delivery begins within minutes after entry of completed document.
Special-same day delivery.
Routine-overnight delivery.

Addressing Options:
Single or multiple address codes can be entered for each document.
Group address codes for preentered multiple address lists can be requested for an entered document.
Single, multiple or group addressing may be combined.
Implied addressing-all documents entered from a specific entry device are automatically routed by the system to one or more addresses pre-defined by the subscriber.

Document Responsibility: Upon completion of document entry, the network becomes the custodian of the document and the entry station is relieved of performing any protocol requirements for output terminal device.

Document Retrieval Service: Document retrieval from the system within a four hour period for up to three days.

Security Services:
Password-concepts applicable to both sender and receiver.
Encryption-system level of encryption applied to all system control information and document logs. Optional encryption by the system of any subscriber documents.
Registered documents-Specific code key must be entered by receiving station before document will be delivered.
Authentication-Provided through the use of passwords and/or subscriber encryption.

Delivery Confirmation: Date and time of delivery provided to sending station on request on a per document basis.

Document Log: System keeps log of all documents entered by each sending location. Subscriber may request the log for the previous day.

Document Receiving Services (rate up to 256 Kbps)

Receiving Modes:
An available-receiving station is assumed to be prepared to receive documents as available from the system.
Pre-arranged-receiving station may only receive documents during a pre-defined time window.
Request-receiving station will request documents when ready to receive.
Registered-document is held in the system until the appropriate receiving station enters a control code.

Document Forwarding: Receiving location, by means of its network control terminal can request that a copy of a document be forwarded to another receiving location.

Accounting Information: System provides each subscriber a detailed accounting of all fixed and variable charges for a billing period. Subscriber assigned document accounting numbers can be associated with charges accumulated in the system.

DATA TRANSMISSION

Point-to-Point Data Circuit on Demand Circuit Set up:
Handled by the network as if a connection exists between sender and receiver. One way or bidirectional logical path is maintained at requested data rate(s) for the desired duration. Passwords applicable to circuit set-up at subscriber's option.

Circuit Data Rate: Fixed data rates from 110 to 56Kbps.

Low-Delay Circuits: Available for interactive data.

Normal Access: Offered under private exchanges class service. Circuit request reinitiated by subscriber if busy condition encountered. Call waiting indication provided to receiving terminals equipped to receive and display it.

Circuit Request Forwarding: Set up request may be forwarded to another receiving station at the direction of the receiver.

MESSAGE SERVICE

Compatibility Transformation: System performs speed matching, code conversion and protocol transformations for many incompatible data terminals and host computers.

Interfaces: Widely used data terminals and host computer interfaces accomodated including the following:
Data Terminal interfaces - a synchronous contention for support of CRT terminals and keyboard printers. A synchronous polled for support of buffered CRT or keyboard printers on multipoint lines. Synchronous polled for support of synchronous cluster controlled and stand alone terminals. Synchronous contention for support of batch and remote job entry terminals.

Host Computer Interfaces-Character-oriented message level under a link control protocol. Bit oriented interface (CCITT X.25)
Terminal emulation support
-ASCII start/stop terminal
-bisynchronous cluster controller
-bisynchronous remote batch terminal

Interactive Service: Low-delay message service provided for interactive traffic.

TELECONFERENCE SUPPORT

Still-frame color, black and white video or electronic black board.
High speed hard copy.
Coordinated voice channels.

OPERATOR SERVICES

User Control Language: Used for making inquiries of the networks, defining address groups, entering implied routing parameters, defining messages formats and validation criteria for specific blanks in the message.

Help Routines: May be called up for step-by-step instruction in the use of operator services.

APPENDIX C

PACKET SWITCHING

Toward the end of the 1960's the technique of packet switching came into experimental use. The first operational packet switching network was the ARPANET, which was designed to interconnect university computer centers and other centers where Advanced Research Projects Agency funded projects were in progress.[1]

In packet switching networks, special purpose communication processors, usually minicomputers accept messages from subscribers, multiplexe them onto a wideband link and switche them from any node to any other node, as shown in figure C1.[2]

The minicomputers divide messages into fixed-bit length segments, called packets. Packets may be thought of as envelopes of a specific size into which data are placed. The envelope contains such vital information as the address and control information.[3]

Packets are transmitted in store-and-forward fashion along the best available path. They are completely error checked by each network computer receiving the packet. Various acknowledgements, as to whether packet is correct or not, are then transmitted.

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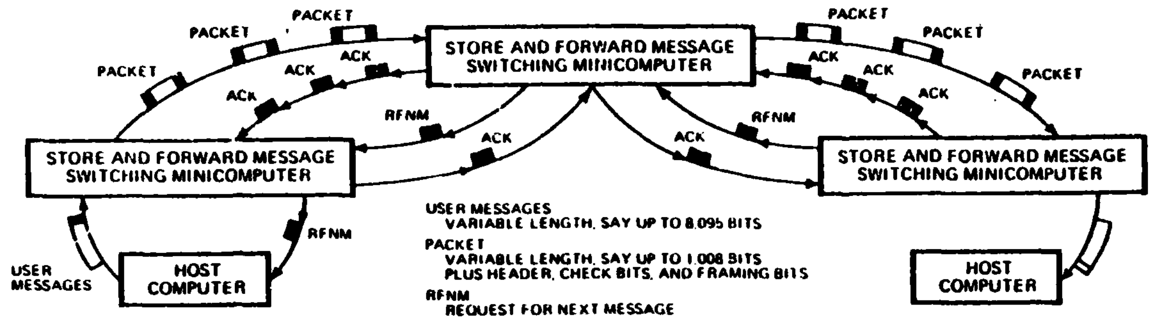
[1] James Martin, Telecommunications and The Computer, Prentice Hall, Inc., Englewood Cliffs, New Jersey, p. 458.

[2] Dixon Doll, "Computer Networking--The Giant Step in Data Communications", Basics of Data Communications, edited by Harry R. Karp, McGraw-Hill Inc., 1976, p. 115.

[3] James Martin, Telecommunications and the Computer, Prentice Hall, Inc., Englewood Cliffs, New Jersey, p. 460.



USER MESSAGES
VARIABLE LENGTH, SAY UP TO 8,095 BITS
PACKET
VARIABLE LENGTH, SAY UP TO 1,008 BITS
PLUS HEADER, CHECK BITS, AND FRAMING BITS
RFNM
REQUEST FOR NEXT MESSAGE

Figure C-1 Packet Switching